

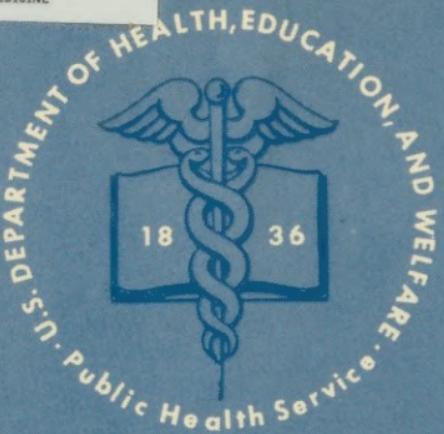
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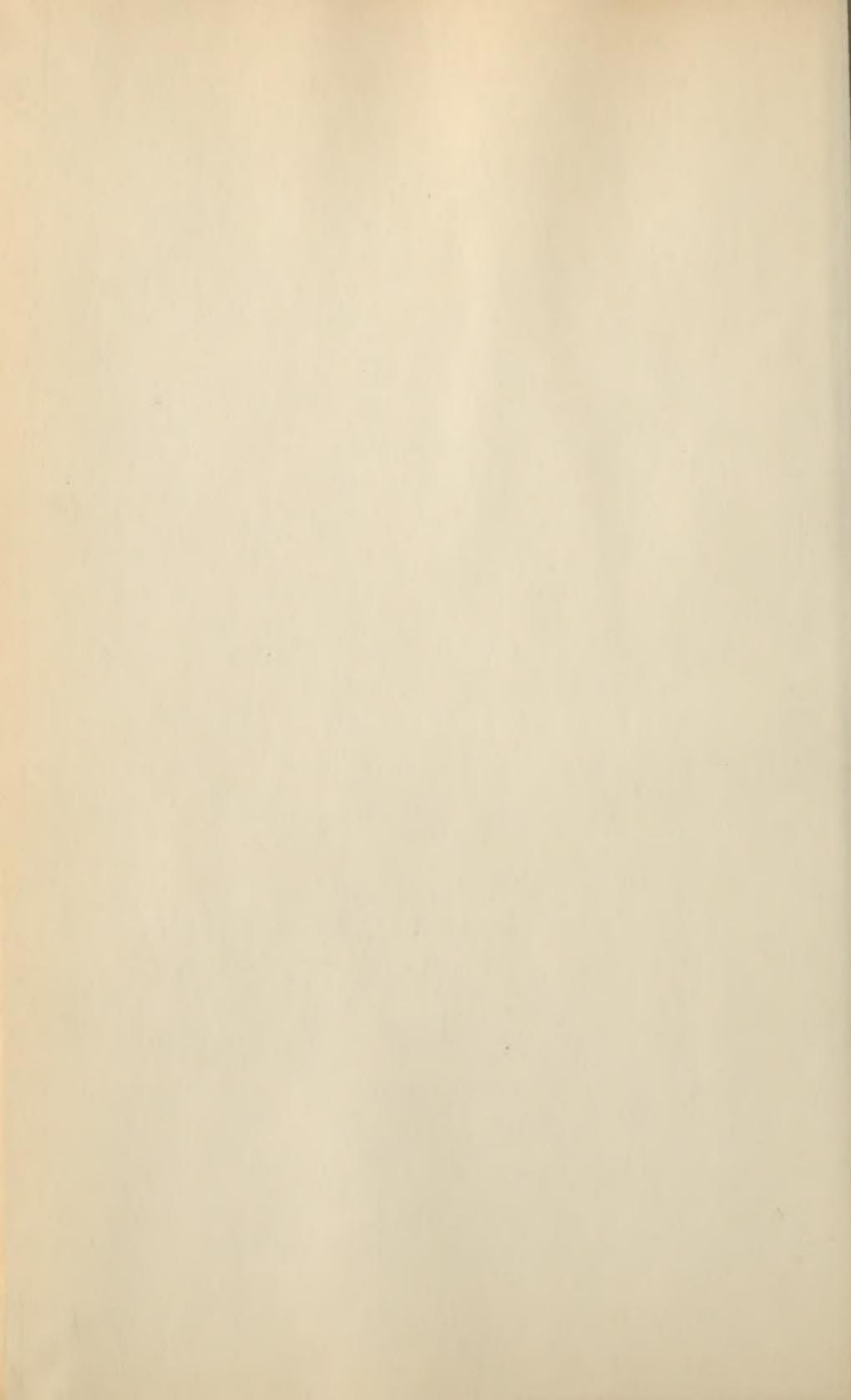


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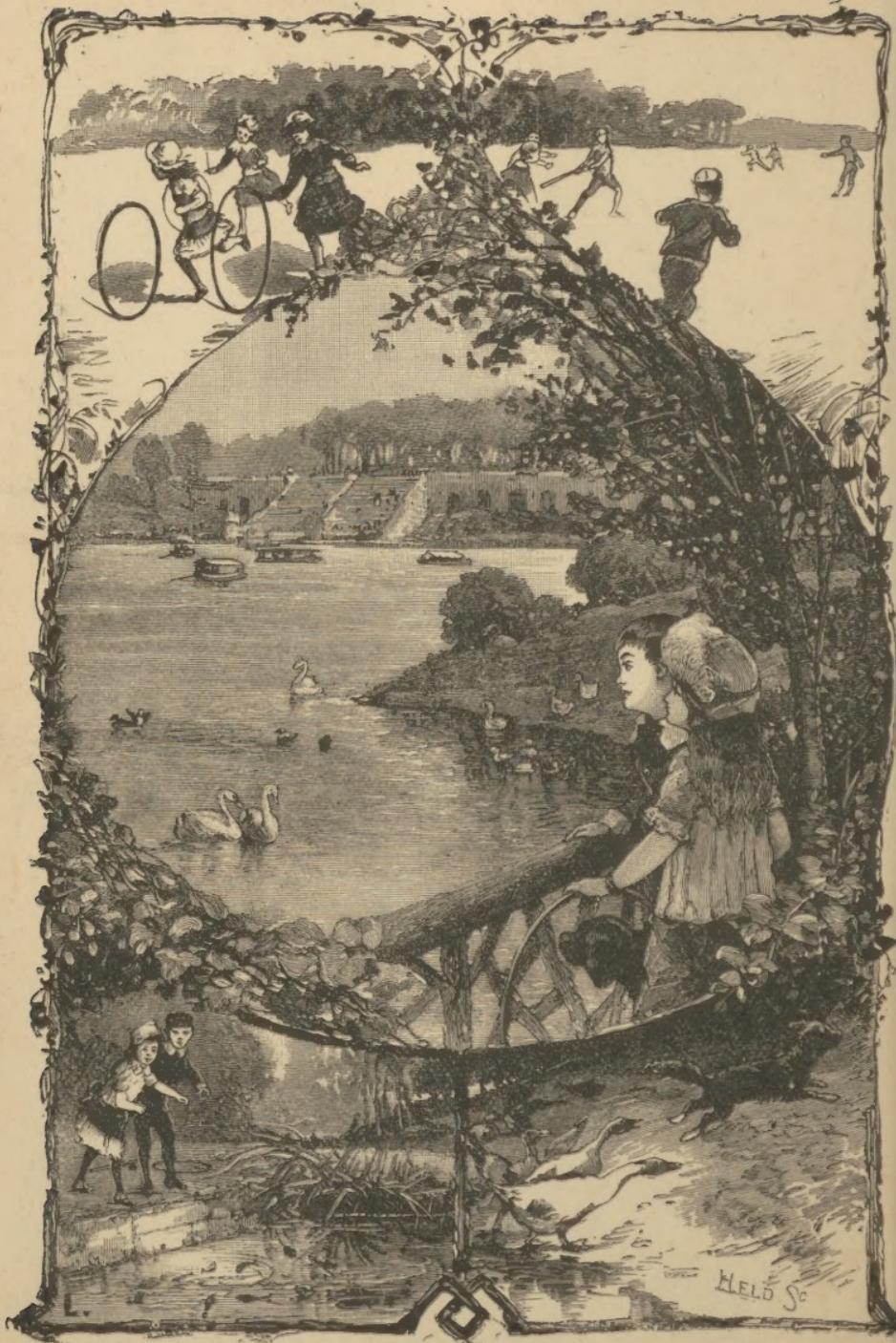
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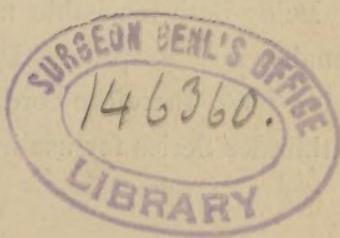
PHYSIOLOGY

FOR

YOUNG PEOPLE

ADAPTED TO

INTERMEDIATE CLASSES AND COMMON SCHOOLS



NEW YORK :: CINCINNATI :: CHICAGO

AMERICAN BOOK COMPANY

FROM THE PRESS OF

A. S. BARNES & CO.

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INDORSEMENT.

BOSTON, June 20, 1889.

The Pathfinder Series of Text-Books on Anatomy, Physiology, and Hygiene consists of the following volumes :

- I. Child's Health Primer (for Primary Grades).
- II. Hygiene for Young People ; }
or, Young People's Physiology. } (for Intermediate Classes).
- III. Hygienic Physiology (for Advanced Pupils).

The above are the series originally prepared (as their general title indicates) to supply the demand created by the laws for temperance instruction in public schools in the United States. They were written by experts under the supervision of the Scientific Department of the National Woman's Christian Temperance Union, published by the instigation of the same, and have been carefully revised from time to time, under the same supervision, to keep them abreast with the latest teachings of science.

Being both teachable and well adapted to grade, their educational value, as proven by school-room tests, is of the highest order. We therefore cordially indorse and highly recommend the Pathfinder Series for use in schools.

MARY H. HUNT,

*National and International Superintendent of the Scientific Dep't
of the Woman's Christian Temperance Union ; Life Director
of the National Educational Association.*

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REFORM

This book has been prepared to meet the demands of intermediate grades of schools. It does not aim to give the teaching in anatomy and physiology which is required by the medical student, but presents only such obvious facts of these as are needed to render intelligible the lessons deemed most important—those on hygiene and temperance.

Since the laws of many States and Territories require that these subjects, including special reference to the effects of alcoholic and other narcotics, shall be studied by all pupils in the public schools, careful scientific teaching on the latter topic is here presented. Further information in regard to distillation, etc., and helps in illustrating the lessons, will be found in the appendix.

Eminent physicians and teachers have contributed helpful suggestions in the preparation of this work. Among the former, are the late Prof. Palmer, M.D., LL.D., Dean of the Medical Department of Michigan University; Dr. Ezra M. Hunt, A.M., M.D., President

of the section of the American Medical Association on State Medicine and Public Hygiene, Vice-President of the American Public Health Association, etc., and author of "Alcohol as a Food and Medicine."

Of the teachers who have helped in shaping these truths into a suitable form for young minds, first mention should be made of Miss Alice M. Guernsey, of Chicago, Ill.

The aid of Dr. Mary V. Lee, of the Oswego, N. Y., Normal School; Prof. Jones, Supt. of Public Instruction, Erie, Penn.; D. B. Hagar, Ph.D., Principal of the State Normal School, Salem, Mass.; Mr. E. P. Church, Supt. of Public Instruction, Greenville, Mich., and other practical instructors, is also gratefully recognized.

INTRODUCTION.

I have examined the manuscript of this book, and find it covering more matter than I think should be taught in the elementary lessons on life and health in the schools, than I have found in the other works, with similar objects, which I have had occasion to examine.

It is free from the errors which have been noticed and objected to in several other works on this subject designed for school use.

I also think it free from such overstatements as are likely to be produced by ardent zeal.

If all the facts contained in this little work are firmly lodged in the minds of the pupils in our public schools throughout the country, an immense work for good will be accomplished.

Being profoundly impressed with the enormous evils to our race produced by the habitual use of narcotics, including alcohol, opium, and tobacco, I can but rejoice at the promising efforts to make obligatory in the public schools the teaching of Physiology and Hygiene, with special reference to these

narcotics, and I know of no work which is a better introduction to the subject than the present text-book.

Of the diseases, the degeneracy, the vices, and the general ill-being produced by the alcohol habit, all observers must be aware.

The evils of the opium habit are scarcely less, in proportion to its more limited extent, and the habit is, if possible, even less likely to be broken up when once established.

The tobacco habit, though less disastrous to individuals and in its moral and social effects upon communities, still, by its greater prevalence, is doing an amount of mischief, especially with boys, which none so fully know as those physicians who have given special attention to the subject.

The influence which indulgence in one narcotic has upon the resort to others, should be more fully recognized, and the great importance of abstinence from all of them will, by these teachings, it is hoped, be more fully understood and appreciated.

It therefore gives me great pleasure to say this much, and in this place, in favor of the objects and the execution of this work, and in commendation of the efforts of those who have had the labor of its preparation.

A. B. PALMER.

ANN ARBOR, Sept. 1, 1884.

TABLE OF CONTENTS.

CHAPTER		PAGE
	PREFACE	iii
	INTRODUCTION	v
I.—FOOD		1
II.—ALCOHOL		13
III.—FERMENTATION		18
IV.—DIGESTION		35
V.—TOBACCO		55
VI.—THE NERVOUS SYSTEM		61
VII.—OPIUM		73
VIII.—RESPIRATION		77
IX.—CIRCULATION		93
X.—THE BONES		109
XI.—THE MUSCLES		127
XII.—THE SKIN		135
XIII.—HEAT OF THE BODY		143
XIV.—EFFECTS OF ALCOHOL IN LIFE		153
XV.—NERVE-ACTION		163
XVI.—HYGIENE OF THE NERVOUS SYSTEM		173
XVII.—SPECIAL SENSES		187
APPENDIX		197
INDEX		209

“Know thyself!” the ages linger
Still before the Delphic shrine!
And with lifted index finger
Trace they yet its mystic line.
“Know thyself!” for nerve and sinew
Powers of good and ill enfold,
And, perforce, the soul within you,
Rests, or struggles, in their hold.
“Know thyself!” God-given forces
Ne'er should mate with brute or clod,
And “the high stars in their courses”
Fight for him who fights for God.

CHAPTER I.

FOOD.

FOOD is any substance which can be taken into the body and used for its health, life, and growth. We must have daily food to repair the daily waste of our bodies, to keep them warm, and, in childhood and youth, to make them grow.

SOURCES OF FOOD.

The earth and the air contain the materials on which our lives depend. But most of these materials must be changed in form, before they are fit for us to eat.

We hold in the hand a grain of wheat. It has no sign of life; no leaves show that it can drink in moisture and sunlight. Its outer husk is hard and dry. It seems no more alive than the grains of sand on which we are standing.

Put it into well-prepared ground. By the help of the sun, air, and moisture, it sends out rootlets into the dark earth, green shoots break through the soil, and the stem lengthens. By-and-by, a graceful plume loaded with the grain that is to make our bread, trembles in the breeze.

Down in the meadow is a beautiful carpet of green grass. It is a good place for play, but you could not eat the grass; you would starve to death if you had nothing else.

But that grass is growing, in order to make food for you. Cattle are feeding on it; it goes into their bodies, and out of it, are made the milk you drink so freely, and the flesh which may come to your table as roast beef or beefsteak.

We eat, unchanged, a few inorganic substances, or substances which have never had life, such as water and salt; but most of our food is organic—has been living,—it has been prepared by plants from the earth and air, or by animals who, by their own eating and living, have changed vegetable into animal matter.

KINDS OF FOOD.

Our food is divided into three great classes—
1st.—Mineral food.

2d.—Food like the whites of eggs, or lean meat, which is needed for the growth or repair of the various parts of the body; it is sometimes called tissue-making food.

3d.—Fats or oils, starch and sugar.

MINERAL FOOD.

This includes all inorganic substances that we eat unchanged, together with some that we get in other kinds of food. The most important of these are water and salt.

If a man weigh 160 pounds, about 140 pounds of this weight is nothing but water—"quite enough, if rightly arranged, to drown him."

Much of this is in the blood, some in the muscles, some in the tears, and the rest in other parts of the body, as you will learn by further study. It dissolves other food, so that the body can use it, and helps to regulate the heat of the system.

We must have water to drink, and it should be pure and good. Death from thirst is quicker and more painful than death from lack of food.

We do not drink all the water which the body requires; for a large part of the amount needed we get in the food itself, as in milk, fruits, vegetables, juices of meat and water used in cooking soups and sauces.

PURITY OF WATER.

Water that runs through lead pipes, is very likely to dissolve some of the lead, if it stands in the pipes for any length of time.

Lead is a very sure poison. Care must be taken to draw off all the water that has so stood, in order to avoid danger. You will learn more about poisoned water in the chapter on respiration.

SALT.

Watch the sheep when the farmer "salts" them, and see how eager they are for the treat. Salt is necessary to man, as well as

to the lower animals; but it exists naturally in most food-materials. A moderate amount of it, as seasoning, makes our food more agreeable and healthful.

LIME, PHOSPHORUS, AND IRON.

The bones need lime, the brain requires phosphorus, and the blood must have iron, in order to be perfectly healthy.

But we can not eat clear lime, phosphorus, or iron. We must get them by eating vegetables which have taken these minerals from the ground and made them into material fit for our use, or by eating the flesh of animals which have fed upon such vegetables.

TISSUE-MAKING FOODS.

Among the most important of these are milk and the grains; they are found, too, in eggs and the different kinds of meat.

Wheat contains more of these foods than other common grains, and bread made from this grain is most nourishing and best.

FATS OR OILS, STARCH AND SUGAR.

These are used, in part, for the growth and repair of the body; but they are of especial use in keeping the body warm.

THE FATS OR OILS.

These are found in both animal and vegetable food; for example, beef and mutton suets, the cream of milk, the yolks of eggs, Indian corn, olive and palm oils.

People who live in cold climates need and crave much of this kind of food.

A story is told of some English sailors who prepared a "Christmas tree," as a treat for a company of Esquimau children. As no suitable tree could be had, they made an imitation one, by tying together walrus bones, shaping the whole to look as much as possible like a tree.

Instead of candy, they made some balls of whale blubber and hung them on the "tree." The children were delighted and ate the balls of fat as eagerly as you eat your Christmas candies.

Some food of this kind is necessary; and,

if one does not like it, he should learn to eat enough of it for health.

Those who do not eat fats of any kind, are usually thin and unhealthy and likely to have some serious disease, as scrofula or consumption, even while young. Butter may be used instead of fat meat if preferred. On the other hand, too much fat must not be eaten; a naturally fleshy person requires less than the average amount.

STARCH.

Starch forms a large part of most grains, seeds, roots, and unripe fruits. It must be cooked, or, in fruits and nuts, ripened, before it is fit for food.

Corn-starch and potato-starch are in common use by the cook and laundress. Rice, the chief food of the people of India, China, and Japan, is three-quarters starch. Unripe fruits, as green apples, contain so much starch that they are very likely to make you sick if you eat them uncooked.

All starchy foods, as those from the grains, require long and thorough cooking to make

them more easily digested and more nourishing.

Gum resembles starch, but is less nutritious. Some kinds, as gum arabic, are used for food in Eastern countries.

SUGAR.

Sugar is an important article of food. But a person would, in time, starve to death if fed alone on either sugar or starch.

Too much sugar is often taken in the form of candy, and does much harm, especially when eaten between meals. The results of eating much candy are a "sour stomach," "bad breath," and other serious troubles. In order to color it, or to increase its weight, injurious substances are often put into candy.

Because of this, colored candies may be really poisonous, and even the white, usually considered the purest, is sometimes largely made of "terra alba," a kind of white earth.

Put a piece of candy into a tumbler with a little water; if it is not pure, when the sugar has dissolved, the terra alba will sink

to the bottom of the tumbler in the form of a white powder.

Thus you can easily prove whether you are eating sugar, or a substance that is worse than useless, because it clogs the body.

M I L K .

Milk is the only food provided by nature for young children. Since the child lives and grows upon it, we should expect milk to contain, as it does, the different classes of food.

The cream is fat, or heat-forming substance; the curd, which can be pressed into cheese, belongs to the tissue-making foods; there is enough sugar to give it a sweet taste, and it contains lime and other minerals needed to sustain healthy life, besides water, of which it has 88 parts in 100.

W H A T T O E A T .

Most people, in temperate climates, eat both animal and vegetable food. You will usually find the three great classes of food on the dinner-tables of your homes.

Water and salt are mineral, and potatoes and meat are heat and tissue-making foods. Most persons crave the fat of butter with the starch of bread.

Pepper, mustard, and vinegar, are not needed in building up the body and should be very sparingly used, if at all. Probably a perfectly natural and healthful appetite would not crave them.

If the system needs acids, lemons and limes, which are more healthful than vinegar, may be eaten. Fresh, ripe fruit which generally contains some acid, is wholesome when too much is not taken.

TEA AND COFFEE.

The value of these to adults is doubted by many wise physicians. Certainly they are not necessary or safe drinks for children.

COOKING.

Health is, in great measure, dependent upon the way in which our food is cooked. Meat should be boiled, roasted, or broiled. Neither meat nor any other food should be

fried: heated fat hardens whatever is cooked in it, making it difficult of digestion.

To eat or drink what we know is unhealthful, because it tastes good, is not only foolish but wicked.

A cook who understands the laws of health, will not feed the family on hot bread, because it makes in the stomach a pasty mass, which can not be easily digested.

Instead of rich pastry, and cake heavy with fruit and spices, which overload the stomach and unfit it for proper work, she will prepare juicy meat, mealy potatoes, ripe fruit, and light, sweet bread. The latter, when it is made from the whole wheat, ground, forms, with the addition of butter, and some water to satisfy thirst, a perfect food.

Fine wheat flour is not so nourishing for the brain and muscles, as that flour which contains some of the outer portion of the kernel. In "bolting," the phosphorus and much of the flesh-making part of the grain are lost.

FRUITS.

Ripe fruits, such as apples, oranges, bananas, and berries, make the most healthful "dessert." The skins, cores, and seeds should not be swallowed, as they are useless and may cause trouble if eaten.

QUESTIONS.

1. What is food?
2. State three ways in which it is used by our bodies.
3. What names are given to the three classes of food?
4. Name the three principal mineral foods.
5. Do we need to drink all the water the body requires?
6. What care should be taken in the use of lead water-pipes?
7. How do we get salt, lime, and other mineral substances for our bodies?
8. Name the principal tissue-making foods;—heat-making foods.
9. Where are fats or oils found?
10. Is it necessary to eat fat of some kind?
11. How is starch made fit for food?
12. Why is green food likely to make one sick?
13. What are the results of eating too much sugar?
14. Show that all three classes of food are contained in milk.
15. Are pepper, mustard, and vinegar, essential to health?
16. Why should a cook understand the laws of health?
17. Why is whole wheat flour better food than finely bolted flour?

CHAPTER II.

ALCOHOL.

ALCOHOL is a colorless, poisonous liquid with a stinging taste; it burns without soot, giving little light, but great heat. It is lighter than water, and can not be frozen.

It is used to dissolve gums, resins, and oils; to make smokeless flames; to take from leaves, roots, barks, and seeds, materials for making perfumes and medicines; and to keep dead bodies from decaying.

ORIGIN OF ALCOHOL.

Water forms the larger part of grape, apple, and other fruit and plant juices. Green fruits contain much starch; as they ripen and become fit for food, this starch turns to sugar. Our sweet-tasting fruits and plants have sugar in their juices; and from such juices, boiled down, we get the sugar used for food.

If this fruit or plant juice is drawn off from its pulp, and then exposed to the open air at summer heat, the sweet part changes: it is no longer sugar, because it has separated into a liquid called alcohol and a gas named carbon'ic ac'id.* Much of this gas goes off into the air; the alcohol remains in the liquid, changing a wholesome food into a dangerous drink.

IS ALCOHOL FOOD?

A perfect food, as we have seen in the case of milk, contains water, tissue-making, and heat-making materials.

Rum, whiskey, wine, cider, gin, brandy, beer, etc., are water and alcohol with different flavors. Many million gallons of alcohol in these liquors are drunk every year by the people of this country. Clear alcohol is seldom used as a drink.

Alcohol is not a food, for it can not build up any part of the body. It contains no mineral substance, and will not make healthy fat.

* A better, but less common name for this gas is carbonic dioxide.

Materials in the blood which should make muscles, bone, etc., as well as those which should be sent out of the body, are sometimes changed into useless fat by the action of alcohol. The heat of the body is lessened by alcohol, instead of being increased.

ALCOHOL AND WATER.

Into a bottle half full of water, pour alcohol to the top; then shake it well, being very careful not to spill any of the liquid. Now, the bottle is not full because the alcohol has united with the water.

Oil and water will not unite; alcohol and water will always unite.

In our study of the human body, which is seven parts out of eight, water,* we shall

* I took one of those remains of the human body which have been preserved some thousands of years, and which is called an Egyptian mummy.

It was probably the body of one who had been a great priest or ruler; for it had been embalmed or preserved in the most expensive form of embalming and had been inclosed in a tomb which must have cost a small fortune.

I measured the mummy,—its length, its girth, and the relative size of its head and limbs and trunk. From these measurements I was able to estimate what would have been the weight of the body when its owner was moving on the earth in the midst of

see how alcohol, beginning at the lips, unites with the water in every part of the drinker's body which it reaches, thus robbing it of the needed liquid.

ALCOHOL A POISON.*

Any substance whose nature it is to injure health or destroy life, if absorbed into the

life and health. The weight of the body at that time, I reckoned, would have been 128 pounds.

In the condition of a mummy, in which it was now before me, nothing remained but the dried skeleton or bony framework, and the muscles and other organs completely dried. The body, in fact, had, in the course of ages, lost all its water.

In this state it weighed just sixteen pounds, and, as eight times sixteen are one hundred and twenty-eight, it is clear that seven parts out of eight of the whole body, or one hundred and twelve pounds, had passed away as water. In the remaining weight was included that of the skeleton, which contains but ten per cent. of water, and some mere remnants of canvas and pitchy substances, which had been used by the embalmers, and which, like the skeleton, still continued perfect.

The soft parts of this human body, by which all its active life, its moving and thinking functions, had been carried on, were, in fact, nearly all removed by the drying process, or loss of water, to which they had been subjected. They had not been destroyed by passing into new forms of matter, as occurs when a dead substance is allowed to decay in the open air; but they had completely lost the water which once gave them size, flexibility, shape, and capacity for motion.—*Dr. B. W. Richardson, of London.*

* The late Dr. A. B. Palmer, of Michigan University, said: "Medical writers admit that by far the most disastrous and frequent cause of poisoning in all our communities, is the use of alcohol."

Dr. W. J. Youmans also wrote of alcohol as a "brain poison."

blood, either in large or small quantities, is called a poison.

Proper food is wrought into our bodies; but poisons are thrown out of them, if possible, because unfit to be used in making any of their parts.

In large doses, in its pure state, or when diluted, as in brandy, whiskey, rum, or gin, alcohol is often fatal to life.

In smaller quantities, or in the lighter liquors—beer, wine, and cider—when used as a beverage, alcohol injures the health in proportion to the amount taken. Alcohol is therefore justly classed as a poison.

QUESTIONS.

1. What is alcohol?—Name some of its qualities.
2. What are the uses of alcohol?
3. From what is alcohol made?
4. What does a perfect food contain?
5. Can alcohol do the work of any of the three classes of food?
6. How does it act to make one fleshy?
7. How does it affect the heat of the body?
8. What is the effect of alcohol upon the water in the human body?
9. Describe Dr. Richardson's experiment with the mummy.
10. How can you prove that alcohol is a poison?
11. Under what names is alcohol drunk?
12. What is the difference between a food and a poison?

CHAPTER III.

FERMENTATION.

WHAT is fermentation? When moist animal or vegetable matters are exposed to warm air, certain changes which take place alter their nature; these changes are produced by a process called fermentation.

When sugar is turning to alcohol and carbonic acid, the latter escapes in little bubbles, giving the entire liquid the appearance of boiling. We call this process, and others much like it, fermentation, from a Latin word which means to boil.

There are several kinds of fermentation. In these lessons we shall learn about only two of them.

I. ***Vinous Fermentation***—the change of sugar to alcohol and carbonic acid.

II. ***Ace'tous Fermentation***—the change of alcohol and other substances to vinegar.

VINOUS FERMENTATION.

FERMENTS AND YEAST.

If you should look at a drop of stagnant water placed under a strong mi'cro scope, you would be quite likely to find it full of small living things, so tiny that you could not see them at all with the naked eye; these minute' animal and vegetable forms are alive, and often in rapid motion.

In the air, also, are many living forms, too small to be seen by the naked eye. One variety of these is called ferment.

These ferment are often found resting on the stems and surfaces of ripe fruits. They have been found in what was before pure water after a bunch of grapes had been washed in it. With the help of the microscope, they have been carefully studied. These ferment from the stems and skins of fruits, or from the air, easily pass into the juice of fruits when it is pressed out. In this they multiply rapidly as they turn its sweet principle, or sugar, to the poison, alcohol.

The juices of the grape, apple, and many other fruits, will, if placed under the right conditions, ferment by the action of these living forms.

In order to ferment some other liquids and thus obtain intoxicating drinks, yeast* must be added. In this way some people brew home-made beer—by steeping various roots, barks, and herbs in water, and adding yeast and sugar enough to cause fermentation. The alcohol that is formed by the change of the sugar, makes the beer a dangerous drink.

When a liquid is fermenting, the little bubbles of carbonic acid carry a froth to the top, which can be used as yeast to act on other liquids. At the bottom lie the "settlings," a half-solid mass, sometimes called the lees. Between the froth and the lees is a thin, intoxicating liquid, which people drink under different names, as, wine, cider, beer, etc.

Dry sugar will not ferment, nor will alcohol be formed in liquids which have an

* Yeast is really a plant, and it is the growth of the yeast plant which causes fermentation in these liquids.

excess of sugar. The united action of sugar, water, heat, and of the ferments in the air, or of yeast—each in the right proportion—is always required to produce alcohol.

IS BEER FOOD?

Starch forms a large part of rye, corn, barley, and other grains. If these are kept moist and warm—as when planted in the earth in spring or summer,—their starch turns to sugar, when the grain, which is a seed, begins to grow. Chew a grain of sprouted corn or barley, and you will find it sweet.

Barley is kept moist with water until it sprouts, or throws out roots. During this process, most of the starch that is in the barley, changes to sugar. Heat is then applied, strong enough to dry out all the moisture of the barley and kill the young roots.

Grain thus treated is called malt, and from this malt, ales and beers are made.

If the sugar thus formed in barley is dissolved out of the grain with water, and yeast is added, and the whole exposed to warm air,

another change takes place,—the sugar which was once starch, becomes alcohol, and carbonic acid. By this process, a good food has been changed to a poison; for the barley has become an intoxicating drink—ale or beer,—and the sugar, turned into alcohol by fermentation, has thus lost its food nature.

The gummy substance left after the starch turned to sugar and then to alcohol, and the hops which the brewer adds, may contain a slight amount of material that the body can use. But the amount of food in beer is so very small, as scarcely to be worth taking into account in speaking of its effects.

“As much flour as can lie on the point of a table-knife is more nutritious than eight quarts of the best Bavarian beer.” (Liebig.)

There is no truth, you see, in the claim that beer makes one stronger. There is no food in it worth mentioning, and its alcohol does a vast amount of harm.

IS WINE FOOD?

A few raisins contain more nourishment than much wine. Sugar in fruit-juice be-

comes alcohol by fermentation; it is the alcohol, which is not food, that the wine-drinker wants. Often more alcohol is added to the wine made from pure fruit-juice, to satisfy the craving for a stronger drink.

The more sugar there is in a liquid undergoing vinous fermentation, the more alcohol will it produce. Sweet apples and sweet grapes make strong cider and strong wine. Currant, gooseberry, elderberry, and other home-made wines, sometimes contain even more alcohol than the wines of commerce, because sugar is added to the fermenting juices.

These home-made wines contain the merest trifle of food-material, and are no more "innocent drinks" than any other kind of wine. The poison, alcohol, is there, ready to do its deadly work.

People not only become intoxicated by drinking these wines; but, by their use, a craving is often created for stronger drinks—such as rum, gin, brandy, and whiskey.

By drinking a larger quantity of the weaker liquors, the user gets the alcohol his

increasing appetite demands. This is especially true of beer-drinkers.

IS CIDER FOOD?

Cider is a fermented drink made from the juice of apples. It consists of alcohol and water, and contains very little that serves as food. In the open air, at summer heat, apple-juice begins to ferment in about six hours after it is drawn off from the pulp, and sometimes sooner.

A little juice often remains in the cider mill after a previous grinding. If this ferments and is allowed to remain, it will act as yeast, hastening fermentation in the juice of the next lot of apples ground.

When little bubbles begin to pass through the liquid and break at the top, as the froth gathers, we may know that the sugar is turning to alcohol. The bubbles are the escaping carbonic acid gas.

The cider that may possibly have been sweet, when it was put into the cellar, continues to ferment, and so gains in alcohol every day, until it begins to turn to vinegar.

There is great danger that the cider-drinker will learn to crave a stronger drink, because alcohol makes those who drink it thirsty for more. Many of those who die as drunkards in this country, began their course at the cider barrel.

If the people who drink cider for its acid taste and effect, would take lemon or lime-juice instead, they would get the acid without the poison of alcohol.

ALCOHOL AND BREAD.

We must not conclude that fermentation is never a good thing. If it is stopped at just the right point, and the alcohol all driven off by heat, it improves some kinds of food.

Grain made into flour, is a food; but, in this form, it is not suitable to eat. Yeast added to warm, moistened flour causes fermentation. A little sugar in the flour itself (called free sugar), turns to alcohol and carbonic acid gas. This gas, in a thin liquid, would pass off into the air. But it is imprisoned by the sticky dough, and puffs it

up with little cells in its effort to escape, thus making the otherwise solid mass, light and spongy.

The small quantity of alcohol which was formed, turns to vapor by the heat of the oven, and passes off into the air; a light, sweet loaf of bread is left, which is better food than the flour.

People who are ignorant of the truths you are learning in these lessons, have supposed that because fermented dough makes good bread to eat, therefore fermented barley-juice must make good beer to drink. But you know the alcohol stays in the beer and not in the bread, and that simple fact makes the difference, in this case, between a food and a poison.

AMOUNT OF ALCOHOL IN FERMENTED LIQUORS.

In one hundred parts of cider—the fermented juice of apples—there are from two to ten parts of alcohol. In one hundred parts of beer—the fermented juice of barley—there are from three to ten parts of alcohol.

Thus it is shown that a man gets about

one glass of pure alcohol in every twenty glasses of cider or beer that he drinks; in stronger beer, such as porter, stout, etc., the proportion of alcohol is still greater.

In one hundred parts of the fermented juice of grapes and other kinds of fruit, or wines, there are from twelve to thirty-seven parts of alcohol (or six to seventeen, by weight).

It was estimated in 1880 that twenty-two and three-quarter million gallons of alcohol were consumed every year by the people of this country, in beer alone.

This makes nearly one half gallon of pure alcohol used by every man, woman, and child of the 50,000,000 people then in this country—if all were foolish enough to drink it.

As very many people drink no beer at all, some of the beer-drinkers must get more than this one half gallon of poison during each year. Further study will show you the fearful consequences of the use of this great quantity of alcohol, and its fatal effects upon the many and varied functions of the body.

HEAT AND FERMENTED LIQUORS.

If you were to place fermented liquors of any kind in an open kettle over strong heat, their charm for the wine, cider, or beer-lover, would soon be gone. It is for the sake of the alcohol they contain, that people are fond of these drinks. As the alcohol passes away in the form of vapor from the boiling liquid, the liquid which is left, has an insipid taste, and no one would care to drink it.

ALCOHOL AND NATURE.

It is a mistake to suppose that because grapes, apples, and barley, are healthful foods, that wine, cider, and beer, made from them, must also be healthful.

It is important to remember that fermentation entirely changes the character of the substance it works upon. Nature rots her various plant forms: but while the juice remains protected from the air by the skin or husk of the unbroken grain, plant, or fruit, its sugar will not ferment—therefore, alcohol is not found in them.

ACETOUS FERMENTATION.

ALCOHOL AND VINEGAR.

After alcohol is formed, if the liquid containing it remains exposed to moderately warm air, the second kind—the acetous fermentation—takes place, changing the alcohol to a sharp acid, called acetic acid, commonly known as vinegar.

When the cook has not baked the bread at just the right time—that is, has not stopped the fermentation before acid began to form in the dough, we say “the bread is sour”. This acid does not pass off in the heat of the oven as alcohol does, but remaining, gives a sour taste to the bread.

Acetic acid is as different from alcohol, as alcohol is from sugar. It is used for food. Vinegar is made in this way from hard cider and other fermented liquors, and will change, in its turn, if left in the same conditions that produced it, and lose its acid taste; its water all evaporating, nothing will remain but a brown powder.

DISTILLATION.

Unless sugar is dissolved in water, alcohol can not be made from it; therefore, when first formed, alcohol is always mixed with water.

Every child who has watched the steam puffing from a tea-kettle, knows that a boiling liquid will turn to vapor. Some liquids boil with less heat than others. This is especially true of alcohol, which, when mixed and heated with water, can be made to pass off in vapor before the water has reached the boiling point.

By continuing a degree of heat that boils the alcohol but does not boil the water, the alcohol finally becomes separated from the water by passing off in vapor, and taking with it but little of the vapor from the water. The escaping vapor of the alcohol being received into a closely covered kettle, called a *still*, through a coil of cool pipes, is turned again to a liquid, the principal part of which is alcohol.

By repeating the process of boiling with

this liquid, and again passing the vapor through the cool pipes, a liquid containing a much greater proportion of alcohol is obtained. These operations can be repeated until nearly a pure alcohol is made.

When a liquid is thus changed to vapor by heat, and that vapor is turned again to a liquid by cold, the process is called distillation (*diſtillatiōn*).

Alcohol and water could not be separated until men learned the process of distilling.

DISTILLED LIQUORS.

In this way, brandy, rum, whiskey, and gin are made. Ordinarily, these distilled liquors are about one half pure alcohol.

DRUGGED LIQUORS.

Wine in its many forms was probably the first, and, for many centuries, the only known intoxicating drink.

The ancients supposed that each of the various fruit-juices made a different kind of liquor; but we now know that all of them are mainly alcohol and water. The different

taste of each is due to its own peculiar fruit, grain, or plant flavor.

Poisonous drugs and coloring matter are often added to alcohol and



PEACH ORCHARD.



water to imitate the various liquors. So much of this is done that many of the fermented and distilled liquors now sold and used, con-



tain other poisons added to their own ever-present one—alcohol. As this is the most dangerous of all, the idea that “unadulterated whiskey” or the “pure, fermented juice of the grape,” can be “good,” is a mistake.

HOW ALCOHOL WAS DISCOVERED.

The people who lived about 700 years ago, thought that somewhere, if they could only find them, were two things that would greatly bless the world. First, something that would turn iron and all common metals into gold, and thus easily and greatly enrich the finder; second, an “elixir of life,” which would prevent sickness and death, and keep those who drank it forever young.

The men who tried many curious experiments in search of these two wonders, were called alchemists (*ăl'kē mĭsts*).

It is supposed an Arab, named Albucasis, was thus led to discover alcohol by distilling it from wine.

His career of intoxication and violence was short. He had found not the “elixir of life,” but the “water of death.”

QUESTIONS.

1. What is fermentation?
2. Why do fermenting liquids appear to be boiling?
3. About what kinds of fermentation have you learned?
4. What are ferments?
5. Where are they found?
6. What produces fermentation in fruit-juices?
7. How are some other liquids made into intoxicating drinks?
8. Why are home-made beers dangerous drinks?
9. What causes froth at the top of a fermenting liquor?—and how is it used?
10. What conditions will prevent the formation of alcohol from sugar?
11. What is necessary to produce alcohol?
12. What forms the chief part of grain?
13. How is the starch in barley turned to sugar?
14. What is malt?—and what is made from it?
15. How does alcohol get into the beer?
16. Compare the food-materials in beer and bread.
17. Do "home-made wines" contain alcohol?
18. How is cider made?
19. Why do cider-drinkers often become drunkards?
20. What acids are more healthful than cider?
21. How can fermentation be made to improve some foods?
22. What makes bread light and spongy?
23. What becomes of this alcohol and carbonic acid gas in the dough? In beer, wine, and cider?
24. How much alcohol is there in beer? In cider? In wine?
25. What effect has boiling on fermented drinks?
26. How is the character of a substance affected by fermentation?
27. Describe acetous fermentation.
28. Why is bread sometimes sour?
29. Contrast acetic acid with alcohol.
30. What is distillation?
31. Why are liquors distilled?
32. Name the principal distilled liquors.
33. How are the different flavors imitated?
34. Are "pure fermented liquors" healthful and safe? Why?
35. What led to the discovery of alcohol?
36. How did it affect the discoverer?

CHAPTER IV.

DIGESTION.

HUNGER and thirst are demands of the whole body for food and water, though only the throat seems to call for the water and the stomach for the food.

Digestion is the preparation of the food which has been taken into the stomach, for the use of the body.

Many wonderful changes must take place, before the beef, potatoes, bread, water, and other food which we eat, can become solid bone and liquid blood, strong muscle, working hand, and thinking brain.

WASTE AND REPAIR.

Tearing down and building up—making and unmaking—these two processes are always going on within us.

If you stand by a city market, early on a summer morning, you may see carts bring-

ing green peas, fresh meat, milk, and other food, from the country farms. Other carts, at the same time, are carrying off barrels of ashes, bones, scraps of food, and other waste matter. They will dump this stuff far enough from the city to prevent any harm to the people from its decay.

Work very much like this goes on in your body. There are certain vessels whose special duty it is to carry the prepared food to the different organs, and others that are the scavengers of the human system.

If you should stop eating, you would starve to death in a short time; if you should keep the waste matter in your body, instead of letting it pass out through the skin, lungs, kidneys, and other organs, you would die even more quickly.

ORGANS OF DIGESTION.

The principal organs of digestion are the mouth, gullet or esophagus (*ē sōph'ā gūs*), stomach (*stōm'āch*), and intestines (*īn tēs'tīnēz*). Taken together, these are often called the food-canal.

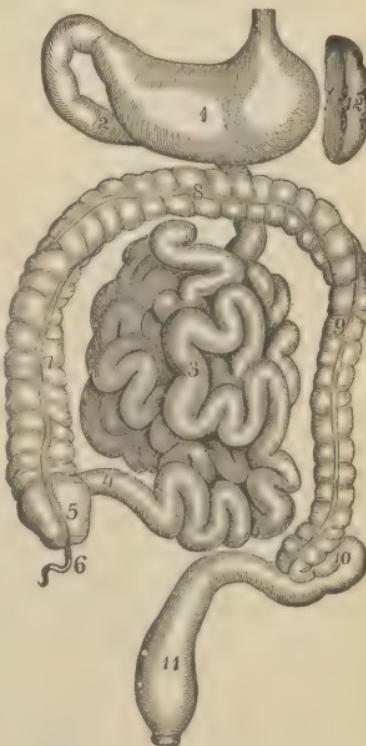
This canal, in a full-grown person, is about thirty feet long. Here and there, beside it, are little fleshy bags called glands; these glands have the curious power of separating certain juices from the blood; this is called secretion (*sē' erē'shōn*).

It is these juices which digest the food. A tongue much coated shows that other portions of the food-canal, as well as the part which we can see, are out of order.

THE TEETH.

The mouth, with its fixed roof and movable floor, takes in the food; the tongue, cheeks, and jaws, move it backward and forward, up and down; the teeth cut and grind it. This should be well done, because the digestive juices can not mix quickly or properly with

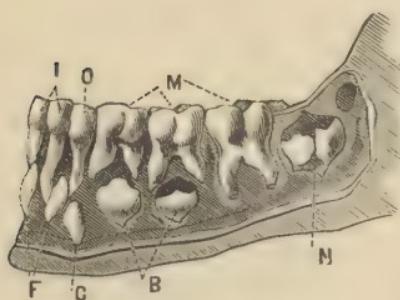
FIG. 1.



The stomach and intestines. 1, stomach; 3, small intestine; 7, 8, 9, 10, large intestine.

lumps of food. A child has twenty teeth;

FIG. 2.



The teeth at the age of six and one-half years. I, the cutting teeth; M, the grinding teeth; F, C, B, N, the new or second set of teeth.

These last for a few years, and are then pushed out by the growth of others behind them. This second set numbers thirty-two in all—sixteen in each jaw.

Those in front are sharp and of use in biting. The back teeth are broad and are

FIG. 3.

*Different kinds of teeth.*

much used in chewing; they are fastened

into the jaws by two or three roots, while the front teeth have each but one root.

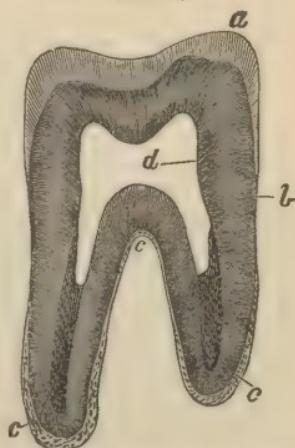
The bone of a tooth is covered with a hard, smooth coating, called enamel (*en ăm'el*), which protects it. If this enamel is broken in any way, the teeth are likely to decay and to cause a great deal of trouble and pain.

CARE OF THE TEETH.

If you wish to have good teeth and to escape the pains of toothache—brush your teeth after each meal, and pick them, if necessary to remove particles of food, with a quill or wooden tooth-pick—never with a pin, lest you break the enamel. For the same reason, never use the teeth to crack nuts or bite thread. “Better to take pains than to have pains take you”.

It is very warm in the mouth—nearly 100° by the thermometer, as warm as the air on a hot July day. At that temperature, a piece of meat would spoil in twenty-four hours.

FIG. 4.



Vertical section of a molar tooth, moderately magnified.
a, enamel of the crown, the lines of which indicate the arrangement of its columns; b, dentine; c, cement; d, pulp cavity.

If we eat meat, therefore, the little pieces which get between our teeth, if not removed, will soon begin to decay in this warm place, and so injure the teeth and gums.

THE SALIVARY GLANDS.

Three pairs of glands—one near and below the ears,* one pair under the tongue, and one pair under the lower jaw

FIG. 5.



—aided by other very small glands that line the inside of the cheeks, pour out a juice called saliva

The parotid—one of the salivary glands.
(sa li'vá), which not only moistens the food, but transforms some of its starch into sugar.

This is the first of the great changes which take place in food during the process of digestion. You will see how important

* It is the glands under the ears—the parotid (pa röt' id) glands—that swell and are so painful when one has the mumps.

it is that the work of the saliva should be thoroughly done, when you remember that unchanged starch does not nourish the body; if not changed in the mouth, it must be changed, but with more difficulty, elsewhere in the food-canal.

“Washing down the food,” even with pure water, will not take the place of slow eating, by which the starch is thoroughly mixed with the saliva and thus changed to sugar. Water simply moistens the food so that it can be more easily swallowed.

If the work of the mouth is but partly done, as by rapid eating, the other organs have more than their share to do; they may soon break down, and their owner suffers from dyspepsia (*dýs pěp'si á*), or some similar disease.

You may prove that starch is changed to sugar in the mouth, by chewing slowly a piece of dry cracker and noticing how sweet it tastes.

To say that “the mouth waters,” is often exactly true. When we think of some favorite food, especially if hungry, the glands may

send an extra amount of saliva into the mouth, as if the food was there ready for its action.

THE ESOPHAGUS.

When divided by the teeth and softened and changed by the saliva, the food is ready to be swallowed, or sent into the esophagus, the passage-way to the stomach.

Look at the throat of a horse when he is drinking, and you will see the motion of the ring-shaped muscles of this tube.

Food and drink do not simply slide down the esophagus; a horse often bends his head when he drinks, so that his mouth is really lower than his stomach.

The muscles contract, one after the other, and push the food gently onward. For this reason, a juggler is able to perform the common trick of drinking a glass of water, while standing on his head.

THE STOMACH.

The stomach is a strong muscular bag in the left side of the abdomen (*ab dō'men*). Its

inner lining has many glands which separate from the blood a juice, called gastric juice. In this is a substance named pepsin (*pěp'sīn*), which digests the flesh-making parts of our food.

The next coat contains muscular fibers. These stretch and shrink in such a way, that the food is gently moved from one end of the stomach to the other, and so forced to mix with the gastric juice.

Some parts of the food are ready for use when they enter the stomach. These are at once taken up by tiny blood-vessels, carried to the liver, and then to the heart.

The process by which these food-materials are taken up and carried into the blood, is called absorption (*ab sôrp'shūn*).

When the work of the stomach is ended, the food which is left is a grayish fluid, called chyme (*kīm*).

Chyme consists largely of the tissue-making substances, and the fats that have been eaten. A part of the starch and sugar, after being prepared in the mouth, has already entered the blood.

THE INTESTINES.

This part of the food-canal is a small tube, about twenty-five feet long in an adult, coiled very closely in the abdomen. You will understand it better by looking at the intestines of a chicken, when the cook is "drawing" it in the kitchen.

Much remains to be done before the chyme is ready to enter the blood. The glands of the intestines are helped by two other glands which lie in the abdomen, one on the right side of the body—the liver—and the other toward the left—the pancreas (*pān'ērē ās*).

These send into the intestines, through a small tube, the bile and the pancreatic (*pān'ērē ăt'īe*) juice, which, with the intestinal juices, divide and prepare the fats.

If the mouth, or the stomach, has failed in any part of its work, these juices in the intestines do their best to complete the task. They can often do but little, however, and so we may lose part of the value of the food.

When fully digested, the milky mass is called chyle (kīl), and is ready to enter the blood. It does this by soaking through the thin walls of blood-vessels and tiny tubes called lacteals (lăc'tē ăls).

STEPS OF DIGESTION.

In a large factory, each man has a special task to perform; the spinners do not attend to the looms, the weavers have nothing to do in the engine-room. So in the body, each part has its own work.

The saliva, to an extent, digests the starch foods. The gastric juice digests the tissue-making foods. The bile and pancreatic juice digest the fats.

If one must eat rapidly, as at a railroad station, the meal should be mainly of meat, as that will give strength and need not be mixed with the saliva for digestion.

The heat of the stomach must be over 100° , in order to digest the food properly. Ice-water at once lowers the temperature: if taken too freely at meals, the stomach must stop working until it can get "warmed

up" again. Such delays in the process of digestion are injurious.

MEALS.

Most healthy persons have three meals a day, at intervals of five or six hours. Since the stomach, like other muscles, needs rest, one should not eat between meals. The mind either helps or hinders the body: the food digests much more readily if there is pleasant, cheerful thought and talk at the table.

An old Eastern story tells of a stranger who met the Plague coming from Bagdad.

"You have been committing great havoc there," said the trader, pointing to the city.

"Not so great," replied the Plague; "I killed only one third of those who died; the other two thirds killed themselves with fright".

ALCOHOL AND THE STOMACH.

As soon as alcohol enters this organ, it is hurried on into the blood-vessels; for the stomach knows it can not be digested, and is useless to the body. But the very short

time it stays there, is enough to cause great harm.

It can not pass through the thin walls of the blood-vessels unless mixed with water. It needs even more water than was contained in the liquors which were drunk; so it shrinks and thickens the delicate lining of the stomach, by robbing it of its moisture. In health, this lining is slightly red, tinged with yellow.

The blood does not move as it should in the blood-vessels of even the "moderate drinker," and those in the stomach soon become swollen. In the drunkard, the case is likely to be still worse; for sores sometimes appear on the walls of the stomach. If one stops drinking liquors which contain alcohol, these will be cured. They do not pain the drinker as they would if on the surface of the body, for reasons which you will understand when you study the nerves.

Sickness, thirst, headache, coated tongue, feverish pulse, go with these conditions of the stomach. The only possible cure is to stop drinking liquor at once and forever.

There is enough alcohol in strong spirits to harden the tissue-making foods, which must be changed to a liquid form in the stomach, before they can be absorbed.

Alcohol, of any considerable strength, separates the pepsin from the gastric juice and prevents its proper action on the food.

Dr. Munroe, of England, proved this by an interesting experiment. He put equal quantities of finely-minced beef into three bottles. Then into one, he poured water and gastric juice from the stomach of a calf; into another, alcohol with gastric juice; and into the third, pale ale and gastric juice.

The bottles were kept at the same heat as the human stomach, and the contents moved about like those of that organ.

The following table shows the results. Study it carefully and see how the clear alcohol and that in the ale, destroyed the power of the gastric juice, by taking out the pepsin from it. It often has a similar effect on that in the stomach, though it remains there but a short time.

<i>Finely-minced Beef.</i>	<i>2d Hour.</i>	<i>4th Hour.</i>	<i>6th Hour.</i>	<i>8th Hour.</i>	<i>10th Hour.</i>
1st. Bottle. Gastric juice and water.	Beef becomes opaque.	Beef separating.	Beef much less in quantity.	Beef broken into shreds.	Beef dissolved as in soup.
2d. Bottle. Gastric juice and alcohol.	No change.	No change.	Slight coating on beef.	No change.	Beef solid on cooling. Pepsin separated from the gastric juice.
8d. Bottle. Gastric juice and ale.	No change.	Cloudy with coating on beef.	Beef partly loosened.	No change.	Beef not digested. Pepsin separated from the gastric juice.

SEEING DIGESTION.

By this time you wonder, perhaps, how all these things are known, when the stomach is covered up in the body.

Some of them the doctors have learned by studying the stomachs of dead persons. But there has been one good chance to look into a live man's stomach and see what was going on there.

In 1822, a man named Alexis St. Martin

was shot in his left side. When the wound healed, it left a hole in his stomach, partly closed by a fold of the inner lining. This could be pushed aside, so that one could look directly into the stomach.

By this means, the doctor who had charge of him, learned much about the digestion of food, and the effects of alcohol upon the stomach. Later experiments upon the stomachs of living men and of the lower animals, have taught us much more on this subject.

OTHER ORGANS OF THE ABDOMEN.

THE LIVER.

This is the largest organ in the body and one of the most important. It fills the whole of the right and upper side of the abdomen. One part of its work is to secrete the bile, or gall, used in digestion.

This juice, when not needed, is stored in a little sac, called the gall-bladder. It is of a dark yellow color, and “bitter as gall” is a common proverb.

The liver also changes, in some way not

clearly understood, the chyme brought to it from the stomach, aids in the manufacture of blood, and in the preparation of worn-out materials for removal from the body.

ALCOHOL AND THE LIVER.

While we can not fully explain all its action, we know that diseases of the liver affect all the other organs. More alcohol goes to the liver and brain than to any other parts of the body. By it, the gall may be changed from yellow to green or black, and from a thin fluid to a thick one.

The liver itself often becomes twice its natural size; in other cases, it is filled with useless fat, like the muscles. When rough and shrunken, with hard lumps or knots, it is called by the English, "hob-nailed," or "gin liver". This condition is caused only by alcohol and is incurable.

The coal-heavers of London drink a great deal of gin, whiskey, and ale. They seem strong, but they often sicken and die from a mere scratch. Their blood is so poisoned from their diseased livers that the wound

festers, does not readily heal, and frequently proves fatal.

THE KIDNEYS.

These are two oval glands at the back of the abdomen, that carry a large part of the waste matter out of the body.

ALCOHOL AND THE KIDNEYS.

A serious, because usually fatal, disease of the kidneys is called "Bright's disease." This may be caused in many ways; but it is most often the result of alcoholic drinks, especially if combined with exposure to wet and cold.

"**Water** supplies every necessity as a liquid for the body."*

Alcohol robs the body of water and can not be used by it as a fluid.

Water dissolves other foods.

Alcohol hardens tissue-making foods, and has no power to dissolve any of the food-materials.

Water helps the digestive juices.

Alcohol separates pepsin from the gastric

* Dr. B. W. Richardson.

juice, coagulates it, and thus interferes with digestion.

Water carries the digested foods into the blood.

Alcohol hinders the digested foods from entering the blood.

Water is the proper liquid of the blood.

Alcohol is injurious to the blood.

Water satisfies our thirst.

Alcohol does not satisfy thirst, but creates a strong craving for itself.

Water, taken in proper quantities, is a healthful food.

Alcohol, taken in any quantity, injures the body in proportion to the amount taken.

QUESTIONS.

1. What is digestion?
2. What two kinds of work go on in the body?
3. What would happen if you were to stop taking food?—if you should prevent the waste matter from leaving your body?
4. Why is a child's face plump, and an old man's wrinkled?
5. Name the organs of digestion.
6. What are glands, and what is their work?
7. How many teeth has a child?—an adult?
8. Describe the teeth.
9. How should the teeth be taken care of?
10. Where are the salivary glands?

11. What is the action of the saliva on the food?
12. Prove that starch may be changed to sugar in the mouth.
13. How do we swallow our food?
14. Describe the stomach. Name its digestive juice.
15. What is the action of the gastric juice on the food?
16. What is absorption?
17. What kinds of food enter the blood from the stomach?
18. Describe the intestines.
19. What juices mix with the partly-digested food in the intestines?
20. What is their action on the food?
21. How does the chyle enter the blood-vessels and lacteals?
22. State the steps of digestion.
23. If obliged to eat in haste, what food would you choose? Why?
24. What is the effect of drinking large quantities of ice-water?
25. How often should one eat?
26. Why should the meal-time be made a pleasant time?
27. How does alcohol often affect the walls of the stomach?
28. What is its effect on the gastric juice? Illustrate by Dr. Monroe's experiment.
29. Give the story of Alexis St. Martin.
30. Describe the liver;—the gall.
31. What are the effects of alcohol on the liver and gall?
32. What is the "gin liver"?
33. Why are slight wounds often dangerous to drinking men?
34. What is a common effect of alcohol on the kidneys?
35. Contrast the effects of water and alcohol.

CHAPTER V.

TOBACCO.

UNTIL within a few years, the Middle and part of the Southern States were the chief tobacco-raising regions of our country. Now, however, the cultivation of tobacco has spread, until many fertile valleys, even as far north as Canada, are devoted to its growth.

The plant reaches a height of several feet, and has large, spreading, pale-green leaves, which are dried, and then made into cigars or prepared to be smoked in pipes, or chewed, or used as snuff.

NICOTINE.

Tobacco, a powerful narcotic, contains a substance called nicotine (ni'e'o tīnē). A single drop, if put on the tongue of a dog, will soon kill the animal. An ordinary cigar contains

nicotine enough to kill two men, if taken pure.

One has to learn to like tobacco. Boys who try it, know that at first it gives them headache, dizziness, and sickness at the stomach. Their poor bodies try to tell them they are taking a poison.

If they keep on, the nicotine deadens their nerves, so they do not feel these effects, though they are more or less injured all the time.

CIGARETTES.

Many boys and young men learn to smoke by beginning with cigarettes'. These seem harmless because they are so small; but they are one of the worst possible preparations of tobacco.

The smoke of the paper wrappings is irritating to the lungs, and the cigarettes send more poisonous fumes into the delicate air-cells, than a pipe or a cigar would.

Drinking men are almost always smokers or chewers, and many a drunkard owes his ruined life and happiness, to the appetite

for narcotics formed by the use of tobacco, and the company into which it led him.

Old cigar-stumps are often picked up from the streets and smoked or made into cigarettes. This is worse than disgusting; for, in this way, diseases may be spread, coming from the mouths of the first users. These stumps are the "strongest" part of the cigars—that is, they contain the most nicotine, which thus goes into the cigarettes.

TOBACCO AND THE MOUTH.

Sores on the lips, and even cancers, sometimes result from the use of tobacco; the breath, foul and repulsive, shows the condition of the stomach, the tissues, and the blood; the gums of smokers and chewers often become spongy, and their teeth are soiled and dark, instead of being white and pure.

The effect of the poison is to make the mouth dry, thus causing an extra amount of saliva to be poured out from the glands. But the constant spitting of the tobacco juice, robs one of the saliva needed for digestion, and thus brings on dyspepsia.

Besides doing this harm to the user, the habit of spitting is a very impolite one. It makes floors and sidewalks unfit for cleanly people to walk on, and endangers the clothing of all who are near.

A man who should spit directly at another would be thought very insulting. Is he respecting the rights of others, though he may not intend to insult them, when he sends the foul juice a little to one side—or where they must tread at the next step, thus placing them in a very unpleasant position?

“The worst characteristic of the habit,” says H. H. Seerley, Principal of the Iowa State Normal School, “is a loss of personal self-respect, and of personal regard for the wishes of ladies and gentlemen, especially when among strangers.”

TOBACCO AND THE STOMACH.

As already said, the nicotine of tobacco is almost sure to cause sickness of the stomach and vomiting, in those who are just beginning to use the poison. It injures the lining of the stomach, hinders the flow of the gas-

tric juice, and, in this manner, seriously interferes with digestion.

Dr. B. W. Richardson says: "One who smokes a pipe is very likely to have dyspepsia."

Dr. Willard Parker wrote: "It is now many years since my attention was called to the insidious, but positively destructive effects of tobacco on the human system. I have seen a great deal of its influence upon those who use and work in it. Cigar and snuff manufacturers have come under my care in hospitals and in private practice; and such persons can not recover soon and in a healthy manner from cases of injury or fever. They are more apt to die in epidemics, and more prone to apoplexy and paralysis. The same is true, also, of those who smoke or chew much."

"The poison is slow, but in the second or third decade its virus becomes manifest. There have died in New York within a few years three excellent clergymen, all of whom might now have been alive had they not used tobacco. The duty of abstaining from

the slow killing of one's self by this poison is as clear as the duty of not cutting one's throat.

"Tobacco is doing more harm in the world than rum. It is destroying our race, and it is sure to destroy the farms producing it, also, as it has done some of the best land in Virginia."

QUESTIONS.

1. In what sections of this country is tobacco raised? Describe the plant.
2. Give proof of the poisoning power of nicotine.
3. What are the usual effects when one uses tobacco for the first time?
4. Why does the tobacco-user not continue to feel these effects?
5. Why are cigarettes especially harmful?
6. How may the use of tobacco be the means of leading one to drink liquors?
7. What are the effects of tobacco on the mouth?
8. What do you think of the habit of spitting?
9. What is the effect of tobacco on the stomach?
10. Give Dr. Parker's statement in regard to tobacco-workers and users.

CHAPTER VI.

THE NERVOUS SYSTEM.

MAN AND OTHER ANIMALS.

IN order to understand the action of the various organs of the body, some study of the nervous system is necessary. In a later chapter, the structure and action of nerves will be more fully explained.

Muscular action, digestion, circulation, and all the work of the body, need to be directed and controlled. This wonderful task is given to the nervous system.

Plants have no power to think or feel: cut a tree, and the bark and wood have no sense of pain; the rose is neither glad nor sorry when you take it from the stem—it knows nothing of what is being done.

The simplest forms of animal life have very little of this nervous power; one of them, the hydra (*hý'drá*), may be cut into

THE NERVOUS SYSTEM.

FIG. 6.



The nervous system. A, cér' ē brūm; B, cér' ē bel' lum.

pieces, and each piece will form a new hydra. But animals which have the sense of feeling —those which can be taught by man—possess most of this power.

The dog obeys his master's orders; horses are trained to understand the slightest word of command. The elephant, though huge and clumsy, is used in India to build bridges, move and pile heavy logs, and to do many other kinds of work.

But no other animal has so complete a nervous system as man; and so, no other animal can think and plan so well. He is placed at the head of living creatures, not to be a tyrant to torment and destroy others; but to "protect all harmless living creatures," and to treat none with cruelty.

PARTS OF THE NERVOUS SYSTEM.

The nervous system is divided into centers, cords, and nerves.

The most important center is the brain; the principal cord is the spinal cord, which passes down the back through a series of holes in the vertebræ; from the brain and

spinal cord, slender white threads, called nerves, extend to all parts of the body. Other nerves start from small centers or knots of nerve-matter, near the backbone.

NERVOUS POWER.

The nerve-centers are mainly composed of soft, gray matter; the spinal cord has a core of this same gray matter, surrounded by white nerve-fibers.

What nervous power is, or how it is made, we do not know; but it begins in the gray matter, and is sent along the white fibers.

The centers are often compared to the stations of a telegraph system where all messages, home and foreign, are received, and whence orders are sent out in every direction. The cords and nerves resemble, in the same way, the wires along which messages are sent.

THE BRAIN.

The brain is protected from injury by the strong bones of the skull, and by three coverings, or coats. The outer coat is very tough;

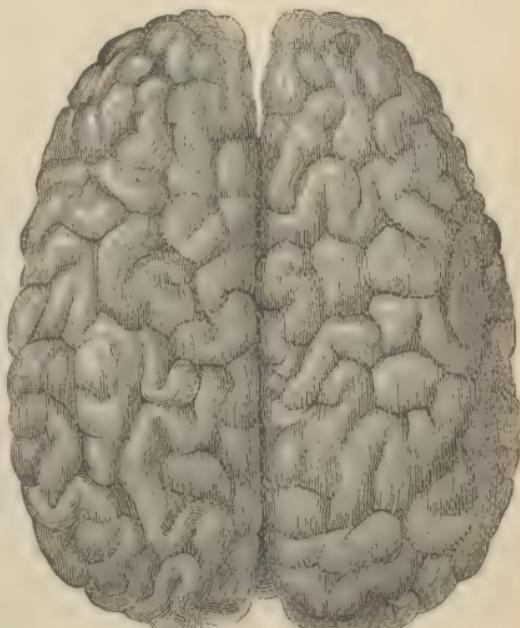
the inner ones are soft and delicate. The two principal parts of the brain are called the cerebrum (*çér'ē brūm*) and cerebellum (*çér'ē běl'lūm*).

THE CEREBRUM.

The cerebrum is the part of the brain in the upper, middle, and front of the head. It has gray matter on the outside, and white nerve-fibers on the inside.

The gray matter is coiled back and forth, so that a great deal is packed away in this part of the skull. You may get a good idea of these wrinkles, or foldings, by looking at a piece of brain coral, or at the meat of an English walnut.

FIG. 7.

*Surface of the cerebrum.*

This is the part of the brain by means of which we think; and wise thinking strengthens it, as proper exercise strengthens the muscles. The greater the power and activity of the mind, the more wrinkled and coiled will the gray matter of the cerebrum become.

THE CEREBELLUM.

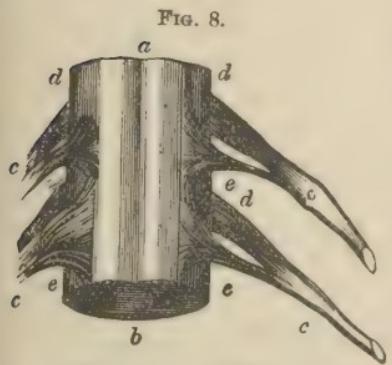
In the lower, back part of the skull, is the smaller division of the brain called the cerebellum.

Like the cerebrum, the gray matter is on the outside; the white matter inside; but the coilings of the gray matter are finer, more like layers or foldings; and the white fibers extend into the gray, in such a manner that they look somewhat like the branch of a tree—this is sometimes spoken of as “the tree of life.”

The special work of the cerebellum is not fully understood. If it is injured, one can not use his body as he wishes; the messages of motion are not sent correctly, the muscles do not obey his will, and he acts as if intoxicated.

THE SPINAL CORD.

At the very base of the brain, is an important mass of white and gray nerve-matter, situated at the upper end of the spinal cord; it is often called the "vital knot," because one nerve which starts from this center, controls the act of breathing.



Section of the Spinal Cord.

a, b. Section of the cord.

c, c, c, c. Spinal nerves.

d, d, d, d. Posterior or sensory roots
of the spinal nerves.e, e, e, e. Anterior or motory roots
of the spinal nerves.

If the knot is injured near this nerve, as is the case when one's neck is broken, respiration stops and death occurs instantly. This part of the brain is so placed as to be protected as fully as possible, and it is rarely injured except in death by hanging.

The spinal cord, as has been said, extends down the trunk through the backbone. It is a white cord, about as large as the end of a man's little finger; down its whole length, front and back, are two deep furrows.

THE SPINAL NERVES.

Thirty-one pairs of nerves pass off from the sides of the spinal cord, divide and redivide, and send tiny nerve-threads all over the body. Touch the skin ever so lightly and you feel the touch, because the cutis is full of nerve-ends.

WHAT IS A NARCOTIC?

Any substance that deadens the brain and nerves is called a narcotic; for example, ether (*ĕ ēr |*) and chloroform (*ĕklō'rō fôrm*), which are given by the dentist, that he may extract teeth without pain. Alcohol is taken for similar purposes, and is a powerful narcotic.

STIMULANTS.

A mistaken idea about the character of alcohol leading people to think it will do what it can not has often led to the formation of the alcoholic appetite, and consequent drunkenness. The notion that a stimulant will add strength or power, and that alcohol is such a stimulant, is one of these dangerous mistakes.

An eminent physician* says: "Alcohol is a narcotic. If taken in large quantities at once, it is capable of completely paralyzing the nervous system. In small quantities, repeated from day to day, it lessens nerve sensibility, blunts mental and moral sense, and slowly, but so surely, prevents the processes of health as to make the system more readily yield to all causes of disease."

If alcohol is a narcotic, why does it seem to excite those who take it? Two facts explain the seeming contradiction.

First. Every increase of the brain's supply of blood is followed by an increase in the activity of that organ.

Second. Besides affecting other nerves that influence the blood circulation, alcohol paralyzes the nerves in the walls of the blood-vessels that run in and out through the brain substance, and that should cause those vessels to expand and contract on the blood within them, regulating its flow. The blood-vessels stretch. Too much blood rushes to the brain.

* Dr. N. S. Davis, President of the International Medical Convention of 1886.

The eyes flash, the cheeks are bright, the words are rapid. But this excitement is not trustworthy. The judgment seems paralyzed also. Such a drinker often says and does what he would otherwise condemn until more alcohol produces complete stupor, and the drinker is said to be dead drunk.

Alcohol, therefore, is not a stimulant in the proper sense of that word; its effect on pain and fatigue, even, is simply the deadening of the nerves, so that one does not realize the disordered, exhausted condition of his body.*

ALCOHOLIC APPETITE.

Like all narcotic poisons, alcohol has the dangerous power of creating an increasing appetite for itself, that demands not only more frequent, but stronger and larger doses. The

* Suppose, for instance, you measure your muscular strength with a health-lift, and then take some of the drink which you think will give you power. When you feel strong, measure your strength again. The drink has fooled you, that is all. You felt that you were stronger than natural; you find that the narcotic has been true to its paralyzing nature and that you are weaker.

Then, after a time, when the drug has spent itself and you feel weak and prostrated, measure your strength once more. Fooled again; the stuff has fooled you twice. When you felt yourself strong, you were weak; and now, when you feel yourself weak, you find yourself really stronger, for your natural strength is returning.—*Adapted from Dr. A. F. Kinne.*

greater its work of ruin, the harder and more nearly impossible to overcome, will be its demand.

The appetite does not gain with equal rapidity upon all; but no one can tell how long he will be satisfied with a little. This craving, so easily formed, and so hard to overcome, clings to its victims. Sometimes after slumbering through years of abstinence (ăb'stī nĕnçē), it is wakened by the first taste.

The custom of putting wine and other alcoholic liquors into cooked foods, is a dangerous one, often causing the formation or return of a fearful appetite.

In this country, many thousand persons every year die as drunkards—that is, are killed by alcohol. None of them expected to become drunkards when they began to drink liquor; but they were ignorant, or careless, of the power of a little alcohol to create an appetite for more.

The word intoxicated means poisoned. The barbarians poisoned their arrows; hence, from the Latin *in*, into—and *toxicum*, a poison into which arrows were dipped, we get

the word which describes the condition of a person under the influence of alcohol.

QUESTIONS.

1. What is the work of the nervous system?
2. Name the parts of the nervous system.
3. What is nervous power?—where does it begin?—along what is it sent?
4. Compare centers, cords, and nerves, to telegraph stations and wires.
5. How is the brain protected?
6. What are the parts of the brain called?—describe each part and its special work.
7. What is the “vital knot”?—where is it?
8. Describe the spinal cord;—the spinal nerves.
9. What is a narcotic?
10. Why has alcohol been called a stimulant?
11. What is its effect on pain and fatigue?
12. How does it seem to increase one's energy?
13. What power have all narcotic poisons?
14. Why should liquors never be used in cooking?
15. How are drunkards made?
16. Explain the meaning of the word “intoxicated”.

CHAPTER VII.

OPIUM.

THE white poppy is a plant which is largely cultivated in India and China. If little slits are cut in the unripe seed-vessels, drops of milky juice come out. When dry, these are carefully scraped off and sold as opium (*o'pī ūm*).

From this opium, laudanum (*lād'ā nūm*), morphine (*mōr' phīnē*), paregoric (*pār e gōr' iē*), and the various kinds of soothing syrups are made. It is one of the most deadly of the narcotic poisons.

EFFECTS.

Usually, these various forms of opium are taken at first by the advice of the doctor, to relieve pain. But the appetite, like that for alcohol and tobacco, grows stronger, and the dose is made larger, as the habit gains upon its victim.

Opium does not make one violent, so as

to injure and murder others, as alcohol often does; but its effects on the users themselves are, if possible, even worse than those of alcohol.

At first, the user seems to be in a pleasant and wonderful dream; then he grows stupid and unconscious. When he comes to his senses again, there is a feeling of horror; to free himself from this, he longs for more of the drug, and will get it if possible.

The continued use of opium leads to serious disorders of the digestive organs, loss of appetite, loss of strength, and general weakness of mind and body. The brain and nerves are especially injured by it, as they are by all narcotics. The power of self-control is lost, and the most solemn promises are broken in order to obtain the poison. Many lives that might have been grand and noble have been destroyed by the use of opium.

Those who have the care of children, frequently quiet them by the use of soothing-syrup. It stops the baby's cry, of course; but it does it by deadening the nerves and poisoning the tender child-life, often leaving

injuries from which it never recovers. An overdose at once kills the little one.

Gin and other liquors are sometimes used for the same purpose. Because this practice injures the health and often creates a craving for alcohol, it is a cruel betrayal of trust on the part of those charged with the care of helpless infants.

OPIUM, CHLORAL, AND THE STOMACH.

Chloral (klō'ral) and chloroform (klō'ro fōrm) are often used in sickness; but, like opium, are narcotics, and therefore dangerous helps. They should never be used in health, or on trivial occasions, or for any length of time.

The stomach of the opium-eater, and of the user of chloral, soon has its digestive power impaired.

THE NARCOTIC HABIT.

One narcotic is very likely to lead to another. A gentleman once tried to break off the habit of smoking, by drinking wine instead. He found the wine was enslaving him; he tried morphine, and soon became its

victim. At last, with a body sadly wrecked, he returned to tobacco, his first enemy, with his naturally fine abilities ruined through the appetite for narcotics.

Turning from one narcotic to another is merely a change of masters. The only hope for the poor victim lies in his power to stop using all these poisons.

QUESTIONS.

1. How is opium obtained?
2. Under what names is it sold?
3. Describe its effects on the user.
4. Why are there more opium-users among women than among men?
5. Why does soothing-syrup stop a child's cry?
6. What other narcotics are used in a similar way?
7. Is it safe and right to so use them? Why?
8. Why are opium, chloral, and chloroform called narcotics?
9. Is any thing gained by changing one narcotic for another?
10. What is the only safe rule in regard to the use of these poisons?

CHAPTER VIII.

RESPIRATION.

INSPIRATION AND EXPIRATION.

PLACE your hands firmly against your sides, and draw long, deep breaths. Notice that the side walls of your chest are not fixed, but move out and in, as you breathe, about eighteen times a minute.

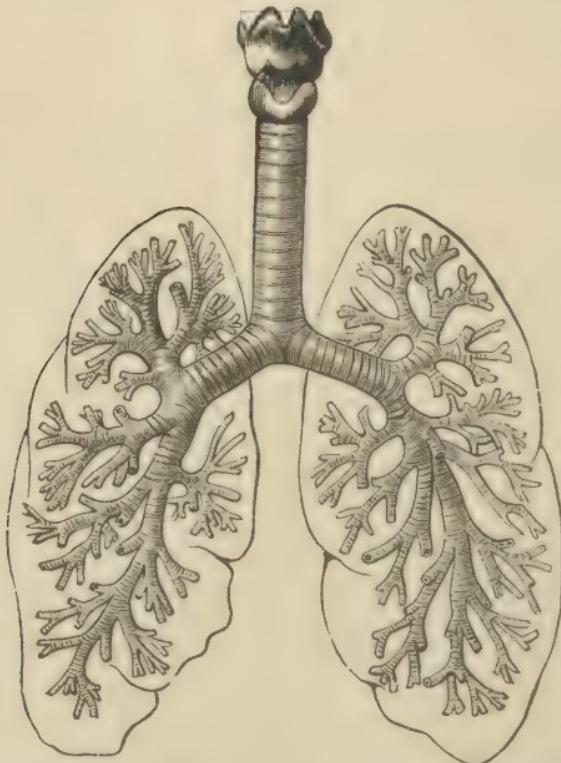
Hold your hand close before your face, and you will feel a current of air upon it, as the ribs move in. Breathe upon a mirror, and a thin film of water covers it, coming from your breath. On a cold winter day, this partly freezes, and you say you can "see your breath."

The diaphragm (*di'a frām*) is a muscle which forms the partition between the chest and the abdomen. When the ribs move outward, this moves downward, and air enters

your chest through the organs of breathing; this is called *inspiration* (*in spɪ rā'tion*).

When the ribs move back into position, and the diaphragm moves upward, the air

FIG. 9.



The lungs, showing the larynx. A, the windpipe; B, the bronchial tubes.

is forced out, bringing with it water and other waste material; this is called *expiration* (*ex pɪ rā'tion*). Taken together, these make up breathing or respiration (*rɛs pɪ rā'tion*).

ORGANS OF BREATHING.

The organs of breathing are the nose and mouth, through which air enters the body, the larynx (*lär' ynx*), windpipe, bronchial (*brōn'-kī al*) tubes, and lungs.

LARYNX AND WINDPIPE.

From the back of the mouth, the air passes down a straight tube at the front of the neck, called the windpipe or trachea (*trā'-kē ā*). This is made of ring-shaped cartilages and is easily felt through the skin of the neck. Its upper end is the larynx, the organ of voice.

The larynx swells out at the front, is larger in men than in women, and is sometimes called "Adam's apple." It is a tube-like box, formed by the union of gristly and elastic parts, and is covered by a movable lid, called the epiglottis (*ĕp' ī glōt' tis*). This is open when we breathe, so that the air can enter. When we swallow, the epiglottis closes the entrance to the windpipe, and the food passes over it to the esophagus.

Sometimes, we try to swallow and breathe at the same time; then this little cover does not shut down quickly enough to prevent particles of food or drink from going "the wrong way." The windpipe can not bear this and coughs them out at once, if possible; if not, we are "choked."

VOCAL CORDS.

We speak by means of the air moving strong bands of membrane, called vocal cords, which are at the top of the larynx. The lips, teeth, and other organs, help us in talking.

BRONCHIAL TUBES AND LUNGS.

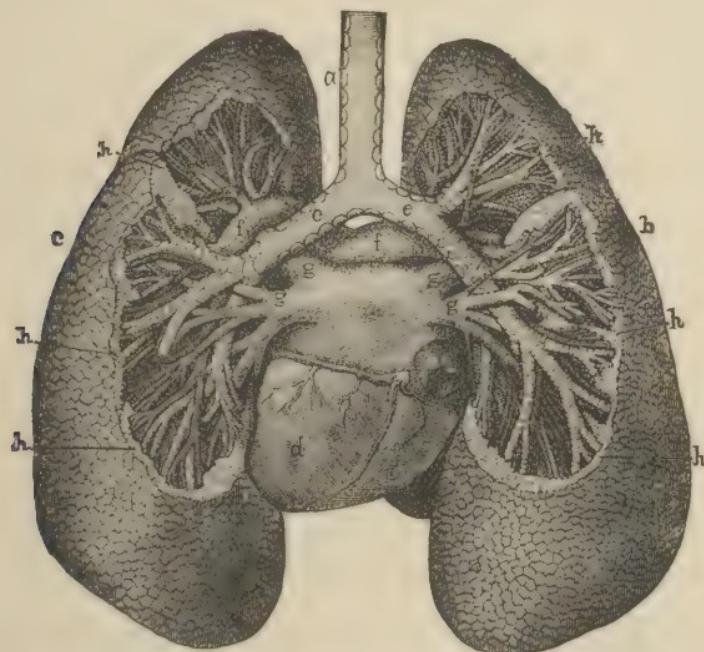
The lower end of the trachea separates into two branches, one of which is sent to each lung; these branches, called bronchi, divide into smaller ones, the bronchial tubes.

These tubes divide and divide again, as the branch of a tree breaks up into smaller twigs. They end in very small sacs, or cells, into which the air passes.

Get a piece of a lung of an ox from the butcher, and put it into a pail of water.

Its little cells are so filled with air that it floats like cork.

FIG. 10.



Interweaving of the air-tubes and blood-vessels in the lungs.

- | | |
|--|--|
| a. Windpipe.
b, c. Right and left lung.
d. Heart.
e, e. Divisions of the great air-tubes
going to the right lung and the left
lung. | f, f. Arteries carrying the blood from
the heart to the lungs.
g, g. Veins, carrying the blood from
the lungs to the heart.
h, h, h, h. Air-cells at the termina-
tions of the air-tubes. |
|--|--|

THE CILIA.

On the walls of the bronchial tubes are minute, thread-like bodies, called cilia (cill'iā). These move back and forth, and help to prevent dust from entering the lungs with

the air, and to carry it out with the mucus (mū'ēüs) when it does get in.

WORK OF THE LUNGS.

A network of tiny blood-vessels, or capillaries (ĕăp'ĕl lă riz), covers the outside of the lung-cells. Having thin walls like the cells, the blood which they carry is brought close to the air in the lungs. By this means, a strange and important change takes place.

Certain waste matters, including carbonic acid and water, pass from the blood through the walls of the capillaries and lung-cells, into the air, and are breathed out at the next expiration. At the same time, the blood takes a part of the air, called oxygen (ox'ī jĕn), which it needs for its own use.

It is this exchange of impurities for oxygen, that changes the dark, blue blood that was sent to the lungs from one side of the heart, to the bright red blood that is ready to nourish the body, and is returned to the other side of the heart, from which it is sent out by the arteries.

This work goes on all the time, whether we

are awake or asleep, and without our thought. If, in order to breathe, we had to think about it, we should have little time for any thing else; and if we forgot it, and so stopped breathing, we should soon die.

HOW TO BREATHE.

Air should enter the lungs through the nose instead of through the mouth. Even when running, if possible, keep the mouth closed. Fewer impurities will pass into the lungs by so doing, and in cold weather the air is slightly warmed before reaching them, making one less likely to "take cold."

Sometimes, as in running, the heart beats so rapidly that the lungs can not keep up with it and supply air enough for the blood; then we are "out of breath."

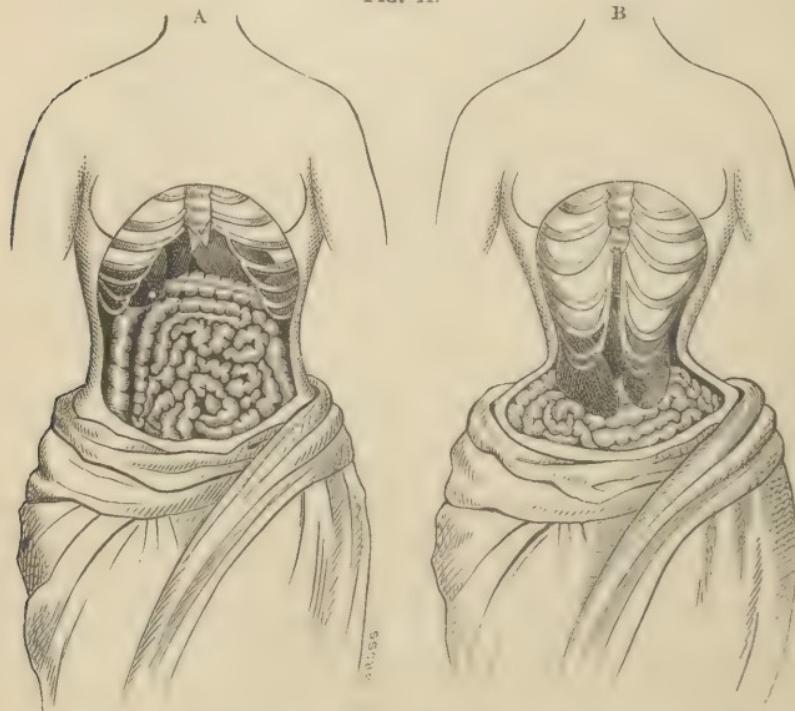
HYGIENE OF BREATHING.

As the muscular walls of the chest and abdomen help in the act of breathing, nothing should prevent their free movement.

For this reason, garments worn about the waist, such as corsets and belts, should never

be tight. They are sure to do harm by crowding the lungs, thus partly stopping the breath, and by pressing out of place the organs of the abdomen.

FIG. 11.



A, the natural position of the internal organs. B, when deformed by tight lacing. In this way the liver and the stomach have been forced downward, as seen in the cut.

Among the many causes of consumption is tight lacing. A small, pinched waist shows that its owner is either ignorant or foolish—perhaps both.

The weight of the clothing should not rest on the hips, pressing the muscles of the abdomen, but be held by shoulder-straps, or by waists kept up by shoulder-straps. Round shoulders, by pressing the lungs out of their proper position, are friends of consumption.

DISEASES.

Bronchitis (*brōn kī'tis*) is a disease of the bronchial tubes, pleurisy (*plū'rī sȳ*) of the pleura, the soft skin covering the lungs; pneumonia (*nū mō'nīā*) and consumption affect the lungs themselves, and croup is a disease of the larynx and windpipe.

All these dangers may be largely avoided by wearing sufficient clothing, by being careful not to "take cold," by eating proper food, and by living in houses that are dry, clean, light, well-warmed, and well-aired, and built in healthy places.

VENTILATION.

Ventilation is the removal of impure or poisoned air from buildings and the supplying of fresh air in its place.

CAUSES OF IMPURE AIR.

In a pleasant village, a few years ago, stood a large house, of which people were afraid, because all who tried to live there sickened, and some of them died.

But one day, a stranger looked over the grounds and house, then bought the estate and ordered repairs; when these were finished, his family moved in, and were healthy and happy there.

The secret of the change lay in the owner's knowledge of the laws of health. He provided a supply of pure water for family use, to take the place of that from the old well into which the drainage soaked. Decaying vegetables, old boards, ancient brooms, and other rubbish in various stages of slimy rottenness, were cleared out of the cellar, from which they had been sending poisonous gases through the house.

A long drain was built to carry the dish-water out into the garden; and refuse matter from the table, such as broken bits of meat and skins of fruit and vegetables, was

burned in the kitchen range, not thrown out at the back door and left to decay.

The neighbors no longer feared the house, but followed the example of its new owner. Gravel and concrete paths and sidewalks replaced those of decaying boards, and piles of old saw-dust from the sheds went to feed furnace fires.

At last, typhoid fever, diphtheria, and malaria, almost disappeared from that locality, because their causes were so largely removed.

Remember that air which contains decaying animal and vegetable matter, is not fit to breathe; and that water, under the same conditions, is not fit to drink. It is well that winds blow poisonous gases away, that the falling rains wash the air clean, and that plants live on carbonic acid which, in sufficient quantity, is fatal to animal life.

VENTILATION OF BUILDINGS.

Waste matter from the body is always passing off by means of the skin and lungs; fires, whether for lighting or heating, send out carbonic acid; sweeping and the tread

of feet set free dust and bits of wool from the carpets.

Unless great pains are taken to keep the air in our houses, school-rooms, halls, and churches, fit for breathing, we poison ourselves.

Janitors of churches, school-rooms, and other public buildings, should never close doors and windows, as soon as an audience has passed out, and shut up the poisoned air to be breathed over again the next time the room is used.

The air in such rooms in cold weather is really carbonic acid gas and other impurities “warmed over.” Doors and windows should be opened on opposite sides, until the fresh air has taken the place of that in the room.

No lesson, sermon, lecture, or concert, can be understood or enjoyed by a sleepy, heedless audience—sleepy and heedless because of the poisoned air it has taken into its lungs.

The headache which we so often have in ill-ventilated rooms, is the common result of re-breathing carbonic acid and other impurities. Thus we see that good studying, preach-

ing, and teaching, as well as good health, are dependent on good air.

Special care should be taken in the ventilation of sleeping-rooms. Leave a close room in which you have spent the night, for a brisk walk in the open air—then return to it again.

The air is foul with the heavy, suffocating odor of waste matter, the product of your lungs, which you have been breathing over and over again during your sleeping hours. You felt stupid and tired on waking, because poisoned by your own breath.

Sleeping-rooms should be so ventilated in the winter, as well as in the summer, that the sleeper may have a constant supply of moderately warm, fresh air. This can be done by raising the lower and dropping the upper sash of a window in a warm room.

Cold air is not necessarily pure air, and, in northern climates, is often too severe in winter to be breathed at night by any but the most robust.

Two openings are needed in order to ventilate a room properly—one through which

the impure air may pass out, and another by which the pure air may enter.

There are many ways of doing this. One is to open the windows a little, both at the top and bottom, as already suggested. Open fire-places are excellent ventilators. Through them, a stream of air from the room goes up the chimney, and air from without must come in to take its place.

While we must have fresh air to breathe, it is not safe to sit or stand in a draught of air.

AIR IN SICK-ROOMS.

The air of the sick-room should be always pure and fresh. To "take the breath" of another person is, of course, to take the carbonic acid and other waste matter from his lungs into your own. Contagious diseases are often spread in this way.

ALCOHOL AND THE LUNGS.

Alcohol, as you have learned, is sent into the blood as soon as possible. The blood carries a part to the lungs, and thus you may

often know from the breath that a person has been drinking.

In passing through them, alcohol injures the delicate air-cells of the lungs. The idea that this narcotic will prevent consumption is a mistake. There is one form of this disease, called alcoholic consumption, which is caused by alcohol.*

The drinker looks well and feels well, till suddenly comes a "dropped stitch," or a pain in the side. Then follow difficulty of breathing and vomiting of blood; then a rapid passage to the grave; for medicine, food, change of air, all prove useless.

* Dr. A. B. Palmer says in a recent work, "Science and Practice of Medicine":—"An impression seems to have obtained a footing in this country, that the use of alcohol, even in excessive quantities, tends to prevent consumption.

"The origin of this opinion it is not easy to discover. It was not imported from Europe; for, so far as I have been able to ascertain, it is not held there by any respectable authority. It is not sustained by any authenticated statistics with which I am acquainted.

"Dr. Peacock, one of the oldest and most highly esteemed specialists in lung diseases in London, and Physician to Victoria Park Hospital for Consumptives, when told of the American notion of the preventive power of alcohol in consumption, and asked whether he thought it prevented the disease, replied, that so far from it, it was a fruitful cause of a certain form of the disease."

Dr. Palmer adds, "Too many persons have been made drunkards from the notion that whiskey prevents consumption, to make the view of its bearings upon morals and intemperance a matter of indifference to the conscientious physician."

Alcohol injures muscular power, and, as the diaphragm and the muscles which move the ribs are used in breathing, respiration is often imperfect in those who drink. Sometimes, these muscles are so affected that paralysis or death occurs. Life depends on respiration, and liquors are the enemy of healthy breathing.

QUESTIONS.

1. Define respiration, expiration, inspiration.
2. Give the names of the organs of breathing.
3. Describe the trachea;—the larynx;—the epiglottis.
4. What are the organs used in speaking?
5. What are the bronchial tubes?—the cilia?
6. Describe the work of the lungs.
7. How should we breathe?
8. How does tight clothing about the waist injure a person?
9. Name diseases of the organs of breathing.
10. How may these diseases be avoided?
11. What is ventilation?
12. Tell the story of the "haunted house" and its changed condition.
13. How did the neighbors improve their premises?
14. How did the result affect the health of the people?
15. How are air and water often made unfit for use?
16. Why do buildings need ventilation?
17. What is said of the air in churches, school-rooms, etc.?
18. Why does a close room often give one the headache?
19. How should sleeping-rooms be ventilated?
20. Is it safe to "take the breath" of another person? Why?
21. How does alcohol affect the lungs?
22. Describe alcoholic consumption.
23. How is alcohol likely to injure the organs of breathing?

CHAPTER IX.

CIRCULATION.

THE BLOOD.

THE blood is a thin, watery liquid in which float millions of little round blood-disks. As most of these are red, the blood looks red.

FIG. 12.



A



B

A, blood-disks of human blood, highly magnified; B, blood-disks in the blood of an animal.

A French writer says: "You feel quite sure that blood is red, do you not? Well, it is no more red than the water of a stream would be, if you were to fill it with little red fishes."

"Suppose the fishes to be very, very small, as small as a grain of sand, and closely crowded together through the whole depth of the stream, the water would look red, would it not? And this is the way in which the blood looks red. Only observe one thing —a grain of sand is a mountain in comparison with the little red bodies which float in the blood.

"In a single drop of blood, such as might hang on the point of a needle, there are millions of these bodies."

CLOTTING OF THE BLOOD.

This rarely occurs in the living blood inside the vessels. But when blood is taken from the body and allowed to stand awhile, the disks collect so as to form a clot, which floats in the watery liquid.

If the flesh is slightly cut anywhere, and the blood flows—as it will, so numerous are the blood-vessels—a clot soon forms at the mouths of the vessels and stops the flow.

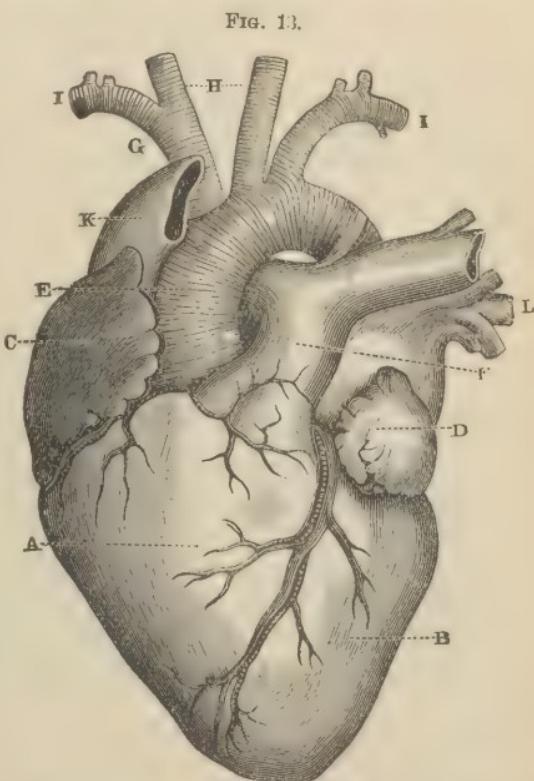
This clot is really a little plug formed by the separation of the parts of the blood.

THE ORGANS OF CIRCULATION.

The heart is placed a little to the left of the middle line of the chest. Connected with it is a set of tubes which carry blood to and from all parts of the body.

The little tubes which carry the fresh blood from the heart to every part of the body are called arteries (*är'ter ɪz*); while those tubes which carry the blood back to the heart* are called veins (*vāns*).

Connecting the arteries and veins are tubes much too small to be seen by the



The heart. A, the right ventricle; B, the left ventricle; C, the right auricle; D, the left auricle.

* The portal vein is an exception to this rule, since it carries blood from the digestive organs to the liver.

naked eye, called capillaries. So very fine are these that the blood-disks have to go through them in single file.

THE HEART.

The heart is a strong, muscular organ, in shape and size somewhat like a very large pear. Around it is a loose bag of connective-tissue.

The heart is divided lengthwise, by a partition called the septum (*sěp'tūm*), into right and left halves. Each half is divided crosswise into chambers which open into each other.

The upper chambers are called the right and left auricles (*ä'yrl'ēls*); the lower chambers, the right and left ventricles (*věn' trī'ēls*). As the blood can not pass through the septum, the heart is really a double organ.

MOTIONS OF THE HEART.

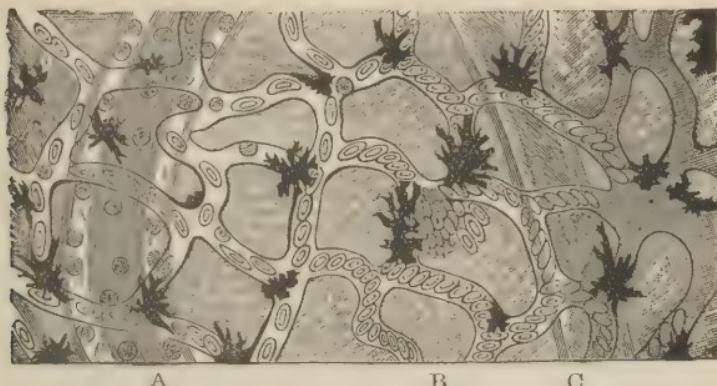
The muscular fibers of the heart are so arranged as to contract the two auricles at the same time. The blood is thus sent into the ventricles, which, in their turn, contract together and so send the blood from the heart.

The walls of the auricles are much thinner than those of the ventricles, since they have to send the blood so short a distance, that but little strength is needed.

COURSE OF THE BLOOD.

We may think of the heart as an engine which pumps the blood all through the body.

FIG. 14.



Circulation of the blood in the web of a frog's foot, highly magnified. A, an artery; B, capillaries crowded with disks; C, a deeper vein. The black spots are coloring matter in cells.

The bright, pure blood is pumped out from the left side through a large artery, called the aorta (*āōr' tā*).

An express wagon, you know, carries different kinds of goods. It may have machinery for a mill, a package of money for the

bank, a silk dress for your mother, or a bicycle (bí'cÿ-elé) for you. The express-man takes each thing to the right place, leaves it there, and then drives away.

So the blood passing from the large artery into the smaller ones, and then into the capillaries, leaves one kind of substance with the bones, another with the muscles, and still another with the skin.

If, by the right kind of eating, drinking, breathing, and other care, we have put proper materials into our blood, it will, in its course through the body, leave what each part needs for its work in keeping us strong and well.

Sometimes, when the express-man leaves a box at a house, he takes away at the same time, a package, or a trunk, for another place. The blood does this, too; but the material which the blood takes away from the different parts, is worn-out or useless matter that must be made over or sent out of the body.

The tiny veins that join the capillaries unite, till at last they form two great veins which bring the blood back to the right auricle of the heart.

By the time it reaches the veins, it carries such a load of waste matter that it is of a dark blue color, as seen in the blood-vessels of the wrist. After eating, newly-digested food forms a part of this venous blood. Sent from the right auricle into the right ventricle, it is then hurried to the lungs.

There the wonderful change takes place which you learned about in studying respiration. The waste matter, largely carbonic acid, is sent off with the breath, and oxygen takes its place. The blood becomes bright scarlet again, and fit to nourish the body.

The veins then carry it to the left auricle and it starts on another journey through the system. It travels so rapidly, as to get back to the heart in less than thirty seconds. From two quarts to a gallon of blood, pass through a man's heart every minute.

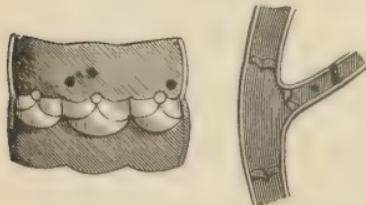
The walls of the left ventricle are much thicker and stronger than those of the right, because they have to contract with force enough to send the blood through the body, while the right ventricle sends it only to the lungs.

This, then, is the course of the blood:

Left side of the heart.—Pure, fresh blood comes from the lungs and is sent out to nourish the body.

Right side of the heart.—Impure, blue blood comes from all parts of the body and is sent to the lungs.

FIG. 15.



Valves of the veins.

This movement of the blood round and round in the body, is called circulation (*cirēū lā'tion*).

Little flaps of delicate skin, called valves, are so placed in the heart and

veins, that if the blood tries to move in the wrong direction, the back-flow is prevented by the shutting of the valves across the passage-ways or tubes.

Brisk exercise of any kind makes the blood flow faster, and thus increases the warmth of the body.

The teamster swings his arms and rubs his hands together in cold weather, because his blood, being chilled, is moving slowly, and he must quicken its flow.

The heat one feels after taking brisk exercise, is more natural and more healthful than that which is obtained from nearness to a warm fire.

THE PULSE.

In adults, the blood is sent out from the heart about seventy times a minute; in children, from eighty to ninety times a minute.

Most of the arteries lie deep in the flesh; but, at the wrist and the temple, they are so near the surface that you can feel the pulse, or the motion of the blood as it is sent through the arteries by the "beating" of the heart.

Usually, if the pulse is much faster or slower than the average rate, the person is ill; the doctor counts the pulse of a patient, so as to know how his heart is working.

Rest is as necessary for the heart as for other muscles. To secure it, there is a slight pause between the beats. Brief as each pause is, if all these moments are added together, they make about nine hours of rest during the twenty-four.

WORK OF THE HEART.

At every beat, the heart moves about four ounces of blood.

Suppose you had a machine which could lift very heavy weights. The coal-man brings you a ton of coal, and you put it into a large box, fasten the box to the machine, turn a crank, and the strong arm of your machine swings the box of coal up into the air with perfect ease.

You try a heavier weight—say twenty-five tons; this also is lifted easily, but not so high as before. Try fifty tons and then seventy-five; the heavier the weight of coal, the less will be the height to which your machine will raise it.

At last, you try one hundred twenty-two tons: the machine can lift this heavy load only one foot from the ground; there it stops, for there is not power enough to raise it any higher.

The heart of a full-grown man or woman uses as much power in moving blood for twenty-four hours, as your machine would

use in lifting one hundred twenty-two tons, one foot high.

This is what learned men mean when they say: "The daily work of the healthy heart in an adult, is equal to lifting one hundred and twenty-two tons, one foot."

CUTS AND WOUNDS.

The blood in the arteries of the limbs is pure and fresh, and in rapid motion; in the veins, it is impure and moves slowly.

The arteries, being deep set, are not easily injured; but, if bright, red blood comes in jerks from a cut or wound, you may know that one is severed. Send for a surgeon at once, but do something while waiting for him; for there is great danger that the sufferer will bleed to death.

Even a child may save a person's life at such a time, if he knows what to do. The flow of blood must be stopped by pinching the artery, as you would stop the flow of water in a rubber hose.

If possible, take a handkerchief, or a towel, or any convenient bandage, and tie it around

the limb close to the wound, and between the wound and the heart. Put a stick into the knot and twist it round and round, just enough to stop the bleeding by pressing the artery.

This will check the rush of blood coming, you remember, from the heart, and enable it to form a clot at the cut end of the tube. Keep the limb raised as you work.

If the blood comes in a slow, steady stream, a vein is injured. The blood in the veins is going to the heart, you know, and is moving much more slowly than that in the arteries. A clot will usually form in the cut veins without the help of a bandage.

If you can not use the bandage, or if this does not stop the bleeding, press a handful of dry earth upon the wound and hold it there until help comes; this is a "remedy that has saved many a life upon the battle-field."

ALCOHOL AND THE BLOOD.

Often the blood is made thin by the enormous quantities of water, or of beer, which

are drunk, because of the burning thirst caused by alcohol. In case of a severe wound, the blood, when it is in such a condition, does not readily clot, and there is greater danger of bleeding to death. While alcohol is in the blood, it acts injuriously upon the vitality of the blood-disks, and, when in great excess, may cause them to shrink.

ALCOHOL AND THE BLOOD-VESSELS.

The motion of the heart is controlled by the nerves. Wherever you find blood-vessels—even the tiniest capillaries—there are nerves entering into their coats and controlling them.

When in a healthy condition, they keep the blood-vessels from stretching or shrinking, so as to hold too much or too little blood.

But, if a person drinks gin, whiskey, wine, cider, or any thing containing alcohol, these nerves are at once deadened by this narcotic; they fail to do their work properly, and therefore the elastic walls of the capillaries stretch, letting in too much blood.

This is often seen in the flushed face, especially in the red, blotched nose, of a drinking man. The unusual amount of blood in the capillaries shows its color through the skin. This is a pitiful sight, especially when we remember that alcohol affects in a similar way, the capillaries of the brain, stomach, and other parts of the body.

ALCOHOL AND THE HEART.

The pendulum regulates the works of a clock, keeping them in motion at the proper rate; remove it, and they "run down," at once. So there are certain nerves which cause the heart to beat, and others which, like the pendulum of a clock, keep it from moving too rapidly.

Alcohol affects the heart, by acting mainly on this last set of nerves which serve as its "brakes." This, like many other of the truths you are learning, has been discovered by experiments on the lower animals and on man.

When these nerves are deadened, the heart beats quicker, but its power is decreased, and

the pulsations are too feeble to send out the blood properly. The rapid working shortens its times of rest, and heart disease is often the result.

TOBACCO AND THE HEART.

The effect of tobacco on the heart is much the same as that of alcohol. The beat is quickened, but the power is weakened: severe pain around the heart is a common result of smoking. There is a form of disease of this organ, which the doctors call "tobacco heart."

QUESTIONS.

1. Describe the blood.
2. What is said of it by a French writer?
3. What is meant by the clotting of the blood?
4. Name and locate the organs of circulation.
5. Describe the heart;—its motions.
6. State the course of the blood.
7. What does the blood carry to every part of the body?
8. What does it take away?
9. What kind of blood is in the right side of the heart?
10. How is the blood changed in the lungs?
11. What kind of blood is in the left side of the heart?
12. What is meant by circulation?
13. What is the use of the valves in the heart and veins?
14. What is the effect of exercise on the motion of the heart?
15. What is the pulse?
16. How often does it beat in children?—in adults?

17. Why does the doctor count the pulse of a patient?
18. When does the heart rest?
19. Compare the daily work of the heart with that of a lifting-machine.
20. How may you know whether an artery or a vein has been cut?
21. If an artery, how would you stop the flow of blood?—if a vein?
22. In what ways is alcohol likely to injure the blood?
23. What control the motion of the heart and the size of the blood-vessels?
24. How does alcohol affect these nerves?
25. What is the cause of the flushed face of the drinking man?
26. What two classes of nerves act on the heart?
27. How does alcohol affect the heart-beat?
28. How does tobacco affect the heart?

CHAPTER X.

THE BONES.

ANY part of an animal or vegetable body which has some special work to do, is called an organ. For example, the root takes up food for the plant; the eye is the organ of sight; the nose is the organ of smell.

Plants and animals are called organic bodies, because they have organs. Stone, iron, coal, and other minerals, are called inorganic bodies, because they have no organs.

The solid parts of the body are called tissues; thus we speak of the fatty-tissue, and the muscular-tissue. Supporting the various tissues about which you have been studying, is

THE HUMAN SKELETON.

This is so much like the skeleton of the ox or the cat, that studying their bones will help us to understand about our own.

The human skeleton is composed of about two hundred separate bones. It forms the frame-work of the body, and furnishes a hard surface to which to fasten the flesh. It also protects the softer parts within, as the heart and lungs.

FIG. 16.



*The thigh-bone
(femur) sawed
lengthwise.*

SHAPE OF THE BONES.

Some are long, like those of the leg and arm; some are flat, like the bones of the head. In the ankle and wrist, they are short and irregular. All are shaped for their special uses in the body.

COMPOSITION OF THE BONES.

The bones are made of both mineral and animal matter.

To prove this, burn the leg-bone of a chicken in a slow fire; the animal matter will pass away, leaving a white substance the shape of the bone, until it is roughly touched —then it crumbles into dust. This is a kind of lime, and is valuable as a fertilizer.

The mineral matter may be removed by soaking a bone for a few hours in weak muriatic acid; the animal matter, or gristle, which is left, is soft and yielding, so that you may bend the bone, or tie it in a knot if long enough.

Both the animal and the mineral matter are needed to make the bones hard and firm, and at the same time tough and elastic. The mineral part alone would make them hard, but brittle. The animal part alone would make them tough, but not firm. It is the union of the two substances that gives to the bones their great strength.

In childhood, the bones contain more animal than mineral matter, and so are not easily broken; in old age, there is more mineral than animal matter, and the bones are brittle and break very easily.

GROWTH OF THE BONES.

Like the rest of the body, the bones are fed by the food we eat.

Mix some bright coloring-matter that is not poisonous, as madder, with the food given

to a young pig for a time, and then give the same food without the color. If the animal be killed after a short time, each bone will show the color of the madder. This proves that the bones were made from the food the animal had eaten.

LIFE OF THE BONES.

In infancy, bones begin their life as a sort of jelly, which hardens into gristle, or cartilage, as the child grows. This cartilage receives from the blood several kinds of food, the most important of which are certain forms of lime; these, little by little, change the soft gristle to hard bone.

Farmers give their hens oyster-shells, which contain lime, so that they may have material for the shells of the eggs they lay. Human beings get lime from milk and other foods containing it. When the bones have too little lime, they are soft and weak.

A fatty matter, called marrow, is in the inside of the long bones, with blood-vessels passing through it and through very small holes in the bone itself, carrying food for its

life and growth. Covering each bone is a very thin, tough skin.

BROKEN BONES.

If an iron rod in a steam-engine should break, would it be enough to fasten the broken pieces tightly, end to end, and then wait a few weeks for the iron to grow together? You laugh at the idea. But the bones do that—they mend themselves when broken.

What is needed is to put the ends in place and fasten them tightly with splints and bandages, so that they can not move. Soon a jelly-like substance, made from the blood, connects the two ends; then this changes to gristle, and, by-and-by, into solid bone, and the break is mended.

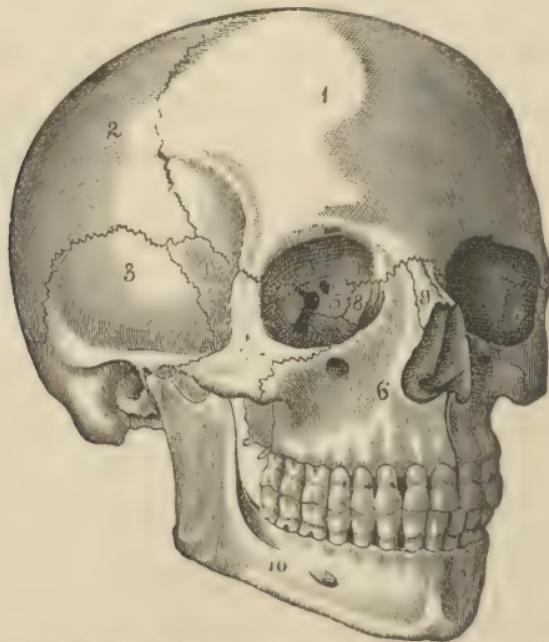
The bones of young people, when broken, unite readily, and, in a few weeks, become as strong as ever. This is due both to the composition of the bones and to the abundant supply of repairing substances in the blood.

A bone broken late in life is a long time in being united, and is likely to remain weak.

THE SKULL AND FACE BONES.

These protect the organs of sight, hearing, smell, and taste, and the brain, the organ of thought.

FIG. 17.



The skull.—1, frontal bone; 2, parietal bone; 3, temporal bone; 6, superior maxillary (upper jaw) bone; 7, malar bone; 9, nasal bone; 10, inferior maxillary (lower jaw) bone.

THE TRUNK.

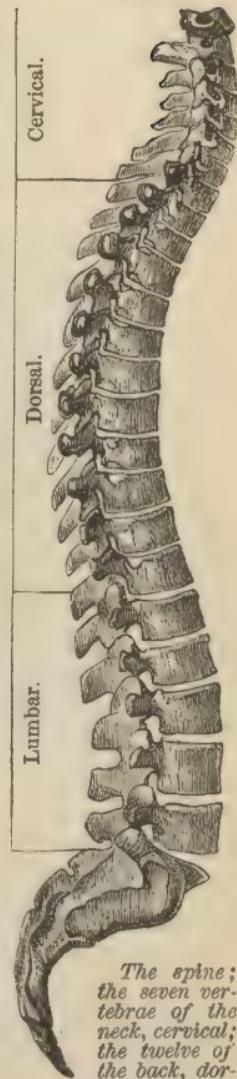
The bones of the trunk are the backbone, or spine, the ribs, the breast-bone, and the hip bones. The spine is composed of a series of twenty-four little bones, called vertebrae.

Cushions of gristle lie between the vertebræ. If it were not for this, walking and running would jar the body greatly.

In sitting or standing, as we do through the day, these cushions are pressed, and so flattened. When we lie down at night, they return to their natural shape, much as a rubber eraser would do if you pressed it with your finger and then took the finger away. For this reason, one is really a little taller in the morning than at night.

The ribs are slender, curved bones, twenty-four in number, twelve on each side of the body. Behind, they are attached to the backbone; in front, seven pairs are joined to a dagger-shaped bone, called the breast-bone; three pairs are joined by gristle to each other, and then to the breast-bone; two pairs are “floating” ribs. (See Fig. 7.)

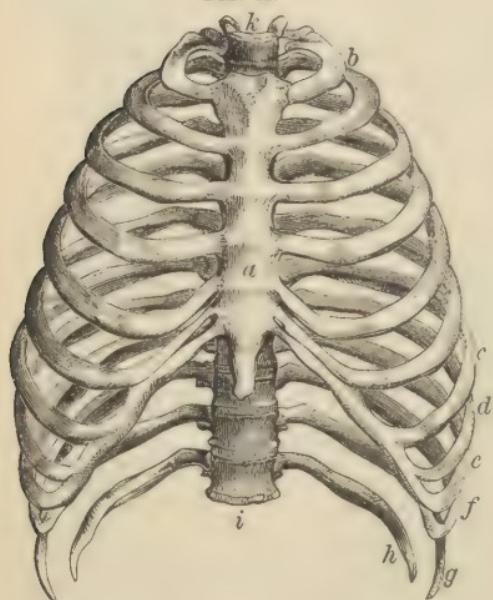
FIG. 18.



*The spine;
the seven vertebræ of the
neck, cervical;
the twelve of
the back, dor-
sal; the five of
the loins, lumbar.*

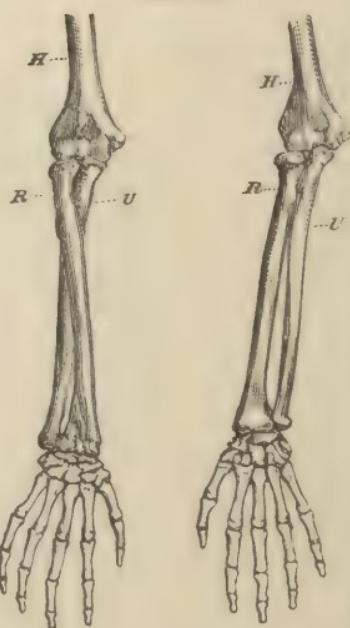
The hip bones are two large, irregular bones which form the side walls of the lower part of the trunk.

FIG. 19.



The chest ; a, the sternum or breast-bone ; b to c, the true ribs ; d to f, the false ribs ; g, h, the floating ribs ; i to k, the dorsal vertebrae.

FIG. 20.



Bones of right fore-arm ; H, the humerus ; R, the radius ; U, the ulna.

THE UPPER LIMBS.

The collar-bones are in front of the upper part of the body; the shoulder-blades, at the back. Fastened to the latter, on each side, is the large bone of the upper arm; below

the elbow, are the two bones of the fore-arm, and those of the wrist, the palm of the hand, and the thumb and fingers.

FIG. 21.



Bones of the foot; a, b, c, d, e, f, g, bones of the ankle and instep; h, i, forward part of the foot; k, l, bones of the great toe; m, n, o, bones of the other toes.

FIG. 22.



The shoulder-joint; a, the collar-bone; b, the shoulder-blade; c, the large bone of the upper arm.

THE LOWER LIMBS.

The thigh-bone, in the leg above the knee, joins the hip bone. Below the knee are the two bones of the lower leg and those of the ankle, foot, and toes. In front of the knee-joint is a small bone, called the knee-pan.

As there are nineteen bones in each hand or foot, they have a great variety of motions. A hand or foot made of one bone, would be stiff and clumsy.*

CAVITIES.

There are two principal cavities, or hollow places, in the bony frame-work.

The first is the cavity of the head. The second is a great hollow place, extending from the neck to the legs, divided into two parts by a strong, yet thin, partition called the diaphragm.

In the upper part—the chest—are the heart and lungs; in the lower—the abdomen—are the liver, stomach, bowels or intestines, kidneys, and other organs.

* Many Japanese and Chinese use their toes almost as readily as they do their fingers. They will pick up tools with their toes and work with them, while managing other instruments in their hands.

Workmen in Constantinople always sit on the ground, even in planing a board; sometimes they hold a long-handled chisel in the left hand, "while the toes guide the cutting edge in turning beautiful forms in a lathe."

"Arabs braid ropes with their toes and fingers laboring in concert." Our toes are so cramped in their stiff leather boots that we do not pretend to use them.

TABLE OF THE PRINCIPAL BONES.

THE HEAD AND FACE.

No.	SCIENTIFIC NAME.	COMMON NAME OR POSITION.
1.—Frönt'äl		Forehead.
1.—Oe čip'i tal		Back of the head.
2.—Pa ri'e tal		Upper side walls of the head.
2.—Tēm'po ral		Lower side walls of the head.
2.—Su pē'ri or Mäx'il la ry		Upper jaw.
1.—In fē'ri or Mäx'il la ry		Lower jaw.
2.—Mā'lar		Cheek.
2.—Nā'sal		Nose.

THE SHOULDER, ARM, AND HAND.

No.	SCIENTIFIC NAME.	COMMON NAME OR POSITION.
1.—Seăp'u lá		Shoulder-blade.
1.—Clăv'i elę		Collar-bone.
1.—Hū'me rūs		Upper arm.
1.—Rā'di ūs 1.—Ul'nā {		Fore-arm.
8.—Căr'pus		Wrist.
5.—Mět a eär'pus		Hand.
14.—Pha län'gēş		Thumb and fingers.

THE TRUNK.

No.	SCIENTIFIC NAME.	COMMON NAME OR POSITION.
24.—	Vēr'te bræ	Backbone.
24.—	Ribs	Side walls of the chest.
1.—	Stēr'num	Breast-bone.
2.—	In nōm i nā'tā	Hip bones.

THE LEG AND FOOT.

No.	SCIENTIFIC NAME.	COMMON NAME OR POSITION.
1.—	Fē'mur	Thigh.
1.—	Pa tē'lā	Knee-pan.
1.—	Tib'i á	Lower leg.
1.—	Fib'u lá}	
7.—	Tär'sus	Ankle.
5.—	Mēt a tär'sus	Foot.
14.—	Pha län'gēs	Toes.

GENERAL DEFINITIONS.

A nāt'o my tells how the body is built and the location of its parts.

Phys i öl'o gy tells the uses of each part of the body.

Hy'gi ēne tells the conditions of health, and how to preserve it.

POSITIONS OF THE BODY.

The bones of children are easily bent out of shape by wrong positions in sitting and standing. Their feet should be supported when sitting, lest the bones of the lower limbs become bent.

The head and shoulders should be thrown back and the body held erect in walking, standing, or sitting, else the spine will become crooked.

The cushions of gristle between the vertebrae permit free and graceful motions of the body. If we stand erect, with the chin quite close to the neck, the head, without being bent forward, is perfectly balanced over our feet.

But if one has the habit of stooping forward, these cushions are so tightly pressed on the front that they lose their elasticity; then one can hardly keep erect, and we say he is "round-shouldered." Bad as this looks, it is the cause of worse trouble, because it prevents the proper action of the lungs.

If the body leans to one side, when one

is standing, the hip bones will soon grow out of shape. Unless careful about this, you will make your body one-sided by your position at the blackboard, or when standing to recite.

In walking, the foot expands in length and breadth. This should be remembered in buying shoes.

The heels of shoes ought to be low and broad, and placed well back; high heels crowd the foot forward and throw the whole body out of position. The shoe should be broad across the ball of the foot and the toes.

Tight shoes and high heels make the toes over-ride each other, spoil the natural beauty of the foot and the graceful carriage of the person, and are likely to cause bunions, corns, and ingrowing toe nails.

The laws of health are of much more importance than those of fashion. Children's shoes must be changed frequently for larger ones, on account of their rapidly-growing feet; if this is not done, serious injury will be the result.

TOBACCO AND THE BONES.

In whatever way tobacco may affect grown people, it is very certain that its use in childhood stunts the bones and dwarfs all the growth of the child. No boy who wants to become a full-grown, well-shaped man, can afford to smoke or chew tobacco.

A boy who uses tobacco runs the risk of being dwarfed in body, mind, and soul;—of becoming a nervous, sickly man, with a weak memory and a feeble heart.

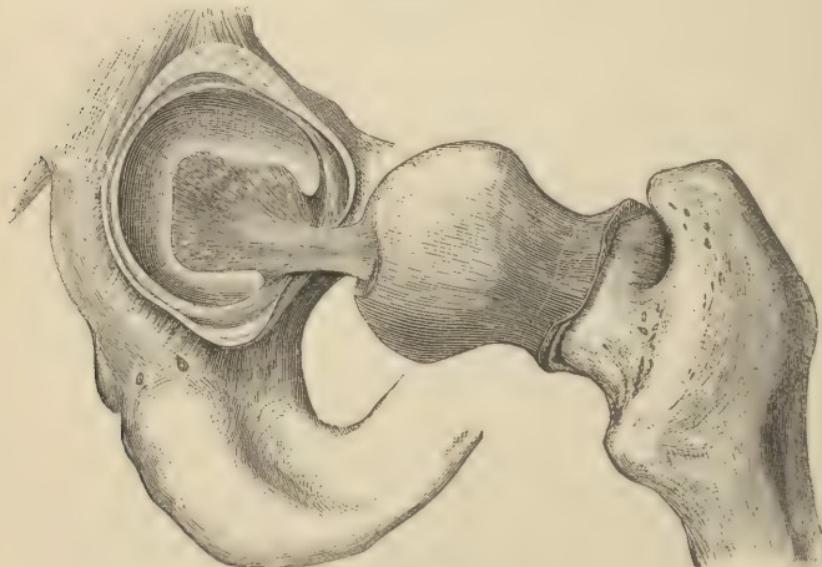
Physicians agree that many and serious troubles result from its use, even by adults;—it is certain that growing boys can never indulge in it with safety.

Dr. A. B. Palmer stated that, in his opinion, young men who learn to smoke or chew tobacco, destroy on an average, by so doing, one fifth of the enjoyment and value, and at least one tenth of the length of their lives.

As with other narcotics, using a little makes one long for more; the boy who begins with one or two cigars a day, soon increases the number.

Many men who are now slaves to this poison, would gladly be free from it; and very few tobacco-users would advise their sons to adopt the expensive, uncleanly, and worse than useless habit.

FIG. 23.

*The hip-joint.*

JOINTS.

A joint is the place of union of two or more bones.

At the shoulder and hip are "ball-and-socket" joints, which permit very easy movements of the arm and leg. In the fingers, wrist, and knee, are "hinge-joints," so named

because the bones move backward and forward like a door upon its hinges. The bones of the head have rough edges which fit into each other, making immovable joints.

An engine must be often oiled, or it will not run properly. It can not take care of itself. But the bones not only mend themselves, but oil themselves. The movable joints are kept moist by a thin fluid like the white of an egg; this comes from the smooth lining of the inside of the joint; and it makes the ends of the bones move readily on each other.

QUESTIONS.

1. What is an organ?
2. Give examples of organs in plant life—in animal life.
3. What are organic bodies?—inorganic bodies?
4. What are the solid parts of the body called?
5. How many bones are there in the human skeleton?
6. What are the uses of the bones?
7. What is the composition of the bones?
8. Why do the bones of a child not break as easily as those of an old person?
9. What mineral food is needed for the bones?
10. How is a broken bone mended?
11. Name the bones of the trunk;—the upper limbs;—the lower limbs.
12. What principal cavities are in the bony frame-work?

13. Define Anatomy; Physiology; Hygiene.
14. How may the bones of the lower limbs be bent?
15. Describe the position in which one ought to stand.
16. What kind of shoes should be worn?
17. What are some of the results of wearing tight shoes?
18. How does tobacco affect the bones of a child?
19. What risks does a boy run in using tobacco?
20. How does the appetite for tobacco change with the use of the drug? Why?
21. Which is the more profitable purchase—tobacco or flour? Why?
22. What is a joint? Describe two kinds.
23. How are the movable joints kept moist?

CHAPTER XI.

THE MUSCLES.

THE muscles are the flesh of the body. They consist of bundles of threads or fibers; between the fibers are blood-vessels and nerves.

The muscles are fastened to the bones by strong, tough cords, called tendons or sinews; these are easily seen, by pulling off the meat from the leg of a fowl. The "lean meat" which we eat is the flesh or muscles of the animal.

Cut, carefully, some boiled corned beef, and you can divide it into the little threads of which it is made. When people have only

FIG. 24.



Tendons of the hand.

small, thin muscles attached to their bones, they are weak and can not do much work.

In some parts of the body, fat lies over the muscles, and is, to some extent, mingled with them. A kind of inner skin, called "connective-tissue," covers the flesh, bones, gristle, and other organs.

EXPANSION AND CONTRACTION.

When a boy raises his fore-arm, saying, "Feel my muscle," each fiber of the muscle on the front of his upper arm has shortened and thickened. This pulls up his fore-arm.

When he stretches his arm, the fibers lengthen and return to their natural shape, and a muscle on the back of the upper arm shortens and thickens in a similar way.

USES OF THE MUSCLES.

It is by means of the muscles that we keep erect, walk, run, leap, or move in any way. The motion of the many muscles of the face gives it variety of expression, showing the feelings of the mind.

Within the skeleton, in the cavities of the

trunk, there are muscles at work, without which we could not live; for instance, the heart, that sends the blood all over the body, is a strong muscle; the outer coat of the stomach has a lining of muscular fibers.

VOLUNTARY AND INVOLUNTARY MUSCLES.

Some of the muscles, as those of the arm or face, we can move when we choose, or will to do so; others, as the heart and diaphragm, keep at work without any thought of ours; they will not stop by our wishing them to.

The first are called voluntary muscles; the second, involuntary muscles.

HYGIENE OF THE MUSCLES.

Good food, pure air, and proper exercise, are necessary for muscular health. Long disuse of a muscle wastes it away. Exercise causes new fibers to form and old fibers to increase in size.

But too much, or too violent exercise is dangerous, and it is wrong to work so hard as to be always tired. Variety of exercise rests the muscles.

One who has been working with hands, or brain, all day, will be rested by a brisk out-door walk. When one has been using his lower limbs for some time, they are tired; if he then sits down, and uses his arms, or hands, and thus rests the muscles of his legs, or uses his brain in thinking or reading, he will feel refreshed.

Brisk exercise should not be taken just before, nor after a full meal. Exercise out-doors is better than exercise in-doors, and should be taken daily by all who would have good health.

KINDS OF EXERCISE.

Playing ball, rolling hoop, throwing bean-bags, coasting, skating, and swimming, are capital forms of exercise, if not carried too far.

Jumping the rope is not good exercise, for it jars the body too much, while there is great danger of catching the feet in the rope and so getting a hard fall, and, perhaps, a broken limb.

Sawing wood, and keeping the wood-box

and coal-hod filled, running home-errands with happy faces and light hearts, are healthful ways of exercise.

Cheerfulness is a great help to exercise. Whistling or singing is a good sign in a working boy or girl.

ALCOHOL AND THE MUSCLES.

Press your finger on lean beef before it is cooked, and notice how the part touched springs back when you take your finger away.

Do the same with fat meat, and you will find that a deeper dent stays there. If the flesh in your body, like the fat, could not contract, you would not be able to move.

Beer, gin, wine, cider, and all alcoholic drinks, tend more or less to change the muscles themselves to fat.

The muscles can not move and work properly, when thus changed; not only does this fat prevent their healthy action, but it is made from waste matter that should be sent out of the body.

Beer is especially bad in this respect. Beer-drinkers think they are growing strong because they grow fleshy. But they are only loading their muscles with this useless fat, which hinders instead of helping them.

Beer-drinkers often die from a certain kind of heart disease, called "fatty heart." The poor heart is not only clogged, but also weakened by this increase of fat, and the more beer one drinks, the greater the increase of fat. The heart bears this abuse as long as it can, and then it stops—the drinker is dead.

LIFE AND DEATH.

Let us try to see with "the mind's eye," the bones, the gristle, the muscles, the tendons and connective-tissue, the cavities of the head, chest, and abdomen with their organs; remember, as we look, that these are all bound together in one life.

The most wonderful thing in the living body is the mind or soul. We think at once, when we see a dead body: "How still and cold it is!" Bodily warmth and motion show

life; but what life is, we have no means of knowing.

Our present study will teach us how to preserve it, and how to keep our bodies strong and healthy.

So important a subject should receive the careful attention of every one, and the rules that are of benefit to health ought to be followed.

QUESTIONS.

1. What are muscles? Describe their structure.
2. How are muscles fastened to the bones?
3. Where is the fat of the body?
4. What is connective-tissue?
5. How do the muscles act in moving the limbs?
6. What is the special work of the muscles on the outside of the skeleton?
7. Give examples of those muscles within the skeleton.
8. Name the two classes of muscles, and define each kind.
9. What things are needed for the production of healthy muscular-tissue?
10. What are the dangers connected with exercise?
11. Is overwork wise or right?
12. How may one rest and yet keep at work?
13. When is brisk exercise unhealthful?
14. What is said of outdoor exercise?
15. Name some healthful kinds of exercise.
16. How does cheerfulness help the muscles?
17. State one difference between flesh and fat.
18. How is the action of the poison, alcohol, likely to affect muscular-tissue?
19. Does an increase of flesh always mean an increase of health?
Why?

20. What should be done with the waste matter of the body?
21. How do alcoholic drinks hinder this change?
22. What is said of beer as a drink?
23. Why is the fat caused by beer worse than useless?
24. How may a "fatty heart" be caused?
25. How does it result in death?
26. State the difference between living and dead bodies.
27. What is life?
28. What do we need to know in regard to it?
29. What reasons can you give for studying physiology?

CHAPTER XII

THE SKIN.

CUTIS AND CUTICLE.

THE skin has two layers. The lower one is called the cutis (eū'tīs), or true skin; the upper one, the cuticle (eū'tī-kīl). These layers never interfere with muscular motion; for they cover the flesh more nicely than the finest glove fits the hand.

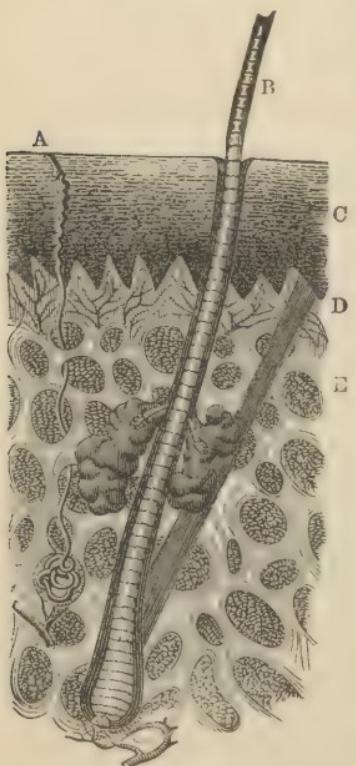
At the lips and nose, this covering changes to a softer and more delicate one, called the mucous membrane (mēm'brān), which extends into the body and forms the lining of most of its organs.

THE CUTIS.

The inner, or true skin, is full of nerves and blood-vessels; it has, also, weak muscular fibers, by means of which the skin is sometimes "puckered" into "goose-pimples," or the hair made to "stand on end."

On the palm of your hand and the ends of your fingers, you can see little ridges called papillæ (pā pi'lē). These contain so many of the tiny nerves by which news is carried to the brain, that our hands are the chief organs of touch.

FIG. 25.



A, a perspiratory tube with its gland; B, a hair with a muscle and two oil-glands; C, cuticle; D, the papillæ; and E, fat-cells.

In the absence of other senses, especially that of sight, one learns to rely upon the sense of touch. The blind read by passing their fingers or lips over raised letters.

THE CUTICLE.

We could not bear to touch the nerve-ends directly, for that would give pain in the hands, almost as severe as the toothache.

The cuticle covers the cutis and protects the nerves.

It is made of hard, dry scales and becomes thicker hands of a blacksmith, or on the feet of a barefoot boy. Its scales rub

off on our under-clothing and on the sheets of our beds. In a blister, bloody or watery matter forces itself between the two layers of the skin.

THE PERSPIRATION.

When a workman comes in from the hay-field on a hot August day, his face is covered with drops of water; so is yours after a run, and you say, you are "sweaty."

This sweat, or perspiration, is a part of the waste matter which must be sent out of the body. It oozes through very small holes in the skin, called pores—so small that you can not see them without a magnifying glass. They are the mouths of small tubes that extend through the skin, the lower end of each being coiled into a tiny ball.

They are most numerous in the soles of the feet, the arm-pits, the palms of the hands, and the forehead. If all these drains of the body were straightened out and laid end to end, they would make a line more than three miles long.

Perspiration is at all times passing off

through the pores; but we notice it only when there is enough to form drops. It cools the body, and suddenly to stop perspiring is one of the first symptoms of heat-stroke or sun-stroke.

Mixed with the water of the sweat is waste matter from the body. The skin is thus one of our most important scavengers, and garments which prevent the perspiration from passing away into the air, are not healthful; the feet become damp and cold, if rubber overshoes, which keep in the moisture, are worn for any great length of time.

A little boy was once covered with gold-leaf to represent an angel in a festival. This kept the perspiration from leaving his body, and he died in a few hours.

THE OIL-GLANDS.

The skin is kept smooth and soft by an oily substance sent out from little sacs in the cutis, called oil-glands. A similar oily material moistens and keeps the hair glossy.

The oil, or sebaceous (*se bā' shūs*), glands are quite large on the face, and sometimes the

matter in them hardens and dries. When their mouths are open, particles of dirt mingle with the oily matter, and they become dark-colored and are often called "worms." They can then be easily pressed out and the black spots removed.

COMPLEXION.

Small grains of coloring-matter on the lower side of the cuticle, cause the different colors of the skin. When these collect in spots, the skin is freckled.

THE HAIR AND NAILS.

These grow from the cuticle. Each hair has a tiny sac, or fold of skin, at its root. The nails protect the ends of the fingers, and grow rapidly.

You may easily prove this, by making a little mark near the base of one of them, and watching it from day to day.

The nails should always be kept clean and well-cut; not bitten nor broken off. Finger-nails, black with needless dirt under the ends, are not the mark of a gentleman or a lady.

BATHING.

The sweat-tubes will not work properly if dirt is allowed to clog or close the openings. Bathing, therefore, is very necessary to the health of the body.

For most strong, well persons, the best time for a bath is just after rising. The water used may be cold, or slightly warm. If hot water is used, a dash of cold water at the close of the bath, with vigorous rubbing, will prevent the tired feeling that would otherwise follow.

Cold water drives the blood away from the skin for an instant; but it comes back when the surface is briskly rubbed, giving a delightful warmth and glow to the body.

A healthy person need not be at all chilled by a cold bath. Uncover only a small part of the body at a time, and wash rapidly and rub well with a coarse towel. If the bath is thus taken, and each part covered as soon as it is dry and warm, no chill will be felt.

All should bathe at least twice a week, and soap is needed on the whole body at

least once a week, to remove the oily matter that has dried upon the skin.

The old idea that it must not be used upon the face is a mere whim. When needed for cleanliness, use it on the face as freely as on any other part of the body.

DISEASES TAKEN BY THE SKIN.

There is danger in using many of the cheap toilet soaps, since they are sometimes made from the fat of diseased animals, and diseases may thus be taken into the system through the pores of the skin.

Soldiers who want to shirk duty, sometimes put a piece of tobacco under each arm-pit. The poison passing through the pores soon sickens them, and the surgeon sends them to the hospital.

Painters and operatives in lead works, are often made sick by little particles of the lead which they handle, entering the pores and poisoning the blood.

Face-powders, hair-dyes, and eye-washes, do great harm in the same way. Good health is the best cosmetic (*eōs mēt' ie*). Noth-

ing else will give such a clear complexion, rosy cheeks, and brilliant eyes. Beauty is much more than "skin-deep."

THE SUN.

Sunlight is necessary for the health of the skin, as well as for all the other parts of the body. In many homes, the closed blinds that keep the carpets bright, keep the people who live behind them, faded and pale.

The trees around a house often shade it so heavily that it is dark and damp. Plants growing in cellars have white, sickly leaves; people living in the dark, lose strength of body and mind, as well as color.

The sunlight should not be shut out from rooms occupied by human beings, except in times of extreme heat.

QUESTIONS.

1. Name the layers of the skin.
2. What is the mucous membrane?
3. Describe the cutis;—the cuticle.
4. What are goose-pimples?—papillæ?
5. What is perspiration? How does it reach the surface of the body?
6. What results from wearing clothing which prevents the perspiration from passing into the air?
7. How are the skin and hair kept smooth and glossy?

CHAPTER XIII.

HEAT OF THE BODY.

USE OF THE THERMOMETER.

THIE blood in the healthy human body has an average heat of 98°; that is, if you should put a thermometer (*thēr mōm' e tēr*) into it as it rushes through its network of tubes, the mercury would rise as high as it does in the shade on a hot summer day.

This result can not, of course, be arrived at directly; but the blood-vessels come so near the surface that a thermometer held in the mouth or in the arm-pit for a few minutes, will show the temperature within the body. Summer or winter, arctic cold or torrid heat, make but little difference in the internal warmth, so long as one is well.

If there is much change in the heat of the body, it is a sign of danger; in fevers, for instance, the doctor keeps careful watch

of the internal heat of the patient's body—if it gets above a certain point, there is no hope of recovery.

But this heat is constantly passing off through the lungs, skin, and other organs. The average amount lost in a day of rest would boil about sixty pounds of ice-water; in a day of work, about eighty pounds. This loss must be balanced by gain.

SOURCES OF HEAT.

The heat of the body results from the many changes constantly going on within it.

The changes which take place in the digestion of food and in the tissues, the beating of the heart, the motion of the blood, the movements of the food-canal, the contracting of the muscles—all the processes of the body, tend to make and preserve its heat.

CLOTHING.

Woolen under-garments should be worn in the winter in northern climates, and many persons require them all the year.

Men who work in very hot places, such

as foundries and engine-rooms, find flannel shirts more comfortable than cotton ones; for they protect from the heat of the fire and do not so readily get wet with perspiration and then allow the body to become chilly.

Loose clothing in several layers is warmer than tight and very thick clothing. The lower limbs of young children, in these days of short pants and short dresses, should be warmly clothed; thick boots and woolen stockings are necessary for their health and comfort, during more than half the year.

A wise doctor often said to his patients: "Never allow yourselves to feel cold. If you are chilly, put on extra clothing, go to a warmer room, exercise briskly, in some way get warm and keep warm." "Only fools and beggars suffer from the cold; the latter not being able to get sufficient clothes, the others not having the sense to wear them."

Tight clothing chills by checking the circulation. Keeping the body too warm by overheated rooms or too much clothing, is another extreme which should be avoided.

None of the under-garments worn during

the day, should be kept on at night, because waste matter from the perspiration, and scales of the cuticle, have collected upon them; they should be taken off and spread out so as to be thoroughly aired for next day.

Outer clothing removed at night should not be hung in closed closets or wardrobes; there is more or less perspiration on it, and this should have a chance to escape. Be sure that closets and wardrobes are often aired.

In the morning, throw the bed wide open, and, if possible, give the sheets and night-clothes a good sun bath. A wise housewife will not have beds made early; but will let them remain open until noon, or even night.

The family will be gainers in the fresh, sweet sleep taken in beds that have been freed from foul matter by the air and sun. Night-clothes should be hung up exposed to the air when the bed is made, instead of being placed under the pillow.

TAKING COLD.

By exposure to a draught of air when one is heated, by sitting with wet feet or in damp

garments, by going into cold air without extra clothing—in these and many other ways, the skin is suddenly chilled. The numberless little pores at once close, and the waste matter can not pass away through them.

It often tries to escape by way of the inner skin—the mucous membrane of the mouth and nose—or by way of the lungs. Then we have a “cold in the head” or “on the lungs,” which may lead to more serious trouble if not attended to at once.

One may guard against “taking cold” by bathing the body often, and by rubbing it daily with a flesh-brush or a coarse towel, thus keeping the pores of the skin in good working order.

ALCOHOL AND COLD.

“Bitter cold! must take something to warm me up,” cries the driver starting on a long winter ride. So he swallows a glass of whiskey; says, “That’s the drink to warm a man;” and drives away. But is he warmer?

Alcohol is a cheat here as elsewhere. The nerves being paralyzed, the capillaries en-

large, and an increased current of blood pours into those of the skin. This makes a glow

at the surface of the body, and the man is sure he is warmer, because he feels warmer.

The heat of this warm blood at once passes off from the sur-

face, and soon more than the proper amount of heat has left the body.

Try the thermometer—that is a better test than the feelings; it shows that the body is really colder very soon after the alcohol has entered it. But the deadened nerves can not carry the message, or sense of cold, to the brain, and no effort is made to prevent being chilled, for the man does not know he is cold. This is the first step toward death, and many a drunkard has been frozen to death when too much intoxicated to feel his danger.

When something must be taken to start again the slow moving wheels of life—as when one is nearly frozen to death—a little red pepper in hot water is an excellent rem-

FIG. 26.



A Wayside Inn.

edy. Clear hot water, hot coffee, or ginger tea, a few drops of ammonia in water, or ammonia (not too strong) held to the nostrils, are also valuable helps in such an emergency.

Arctic explorers have proved that alcohol is worse than useless in helping them bear extreme cold. Dr. McRae says: "The moment that a man had swallowed a drink of spirits, it was certain that his day's work was nearly at an end. . . . In that terrific cold, the use of liquor as a beverage, when we had work on hand, was out of the question."

Until lately, the explorer who had gone nearest to the north pole was an Englishman named Adam Ayles. He was proud of being able to say there had never been a drop of alcohol in his body. When in the extreme cold of those regions, he bore the hard work of sledging and hunting much better than the men who used liquor now and then.

Many of those who drank liquor became sick and helpless. When urged to drink liquor, Adam Ayles replied bravely: "No! when a boy, I promised my mother never to touch it; and, if I perish in this ice, I will

keep my word." He returned to England alive and well.

FIG. 27.

*Scene in the Arctic Regions.*

When a detachment of the Russian army is about to start on a winter expedition, a corporal goes the rounds to smell the breath of each soldier. Those who have been drink-

ing liquor are sent back to their barracks, since they can not endure the cold march.

ALCOHOL AND HEAT.

Alcohol is no better protection against heat than against cold. Livingstone, the famous African explorer, has proved that men can endure more in tropical climates without it than with it.

QUESTIONS.

1. What is the average heat of the human body?
2. How do doctors use the thermometer in sickness? For what purpose?
3. What does a change in the temperature of the body indicate?
4. How does the heat of the body pass away?
5. How is more heat supplied to balance this loss?
6. What is said of woolen under-clothing?
7. Why is flannel worn by those who work in very hot places?
8. How should the feet and legs of children be dressed?
9. What should one do if chilly?
10. What is said of tight clothing?—of keeping the body too warm?
11. What should be done at night with the garments worn during the day?
12. How should sheets and night-clothes be aired?
13. Is alcohol a good preventive of chills?
14. Why does one feel warmer after drinking a glass of whiskey?
15. Is he really warmer or colder? Why?
16. How would you prove this?
17. Why is a man, under the influence of liquor, not apt to feel cold?
18. Name some good remedies for cases of prostration from cold.

19. What do Arctic explorers say of the use of alcohol?
20. Give the statement of Dr. McRae.
21. What was the experience of Adam Ayles in the Arctic regions?
22. What was his reply, when urged to drink liquor?
23. What test is made in the Russian army?
24. Why are Russian soldiers, who have been drinking, sent back to their barracks?
25. What is said about alcohol and heat?
26. Give Livingstone's testimony.

CHAPTER XIV.

EFFECTS OF ALCOHOL IN LIFE.

WORK.

A VESSEL coming from Australia sprung a leak soon after starting, and the men had to work at the pumps all the way home.

At first, regular rations of liquor were given; but the sailors soon began to grow weak and tired. Then the captain stopped the use of liquor, giving an extra supply of food, instead. At once, the men began to sleep well and to waken strong and rested.

In spite of the hard work at the pumps, the crew were in good health when they reached England. The liquor deadened—narcotized—the nerves which control muscular action, and the men lost strength thereby; the food furnished building material for their bodies and so increased their working power.

“The following statement was made by Sir William Fairbairn, an eminent engineer of Manchester, England, when at the head of a firm employing between one and two thousand workmen:

“I strictly prohibit on my works the use of beer or fermented liquors of any sort, or of tobacco. I enforce the prohibition of alcoholic drinks so strongly, that if I found any man transgressing the rule in that respect, I would instantly discharge him.”

“The reasons for these measures are thus stated:

“In those foundries in which there is drinking throughout the works all day long, it is observed of the men employed as workmen, that they do not work so well; their perceptions are clouded, and they are stupefied and heavy.

“I have provided water for the use of the men in every department of the works. In summer-time, the men engaged in the strongest work, such as strikers to the heavy forges, drink water very copiously.

“I am convinced that workmen who

drink water are really more active and do more work, and are more healthy than those who drink alcoholic liquors.'

"This is the testimony of all accurate observers."—*Dr. A. B. Palmer.*

Observation of the effects of alcohol shows us—

1st.—That the healthy action of the muscles is hindered by the useless fat formed through the influence of alcohol.

2d.—That the nerves are deadened.

3d.—That strength is lost rather than gained by the drinking of alcoholic liquors.

LIFE INSURANCE.

Those who never drink liquor have a prospect of living much longer than those who do. Many diseases are caused by alcohol, and many more are made worse by it.

Of diseases like the cholera and yellow fever, pure air, clean houses and streets, and blood unpoisoned by alcohol and tobacco, are the best preventives.

In 1832, when the cholera was in London, this notice was posted by the city officers:

"Spirit-drinkers will be the first victims of the cholera." The poisoned bodies of alcohol-users rarely can resist the disease.

Life insurance companies keep careful records, showing how many years different classes of men will probably live. Here are some of the results of their study in England:

When a total abstainer is

20	years old,	he may expect to live	44	years more.
30	" " "	" " "	36.5	" "
40	" " "	" " "	28.8	" "

When a moderate drinker is

20	years old,	he may expect to live	15.5	years more.
30	" " "	" " "	13.8	" "
40	" " "	" " "	11.6	" "

From these records, it is plain that those who never drink liquor have the best chance for length of life, as well as for happiness and power to work.

The President of one life insurance company in New England says of beer-drinkers:

"The deaths among them were astounding. Robust health, full muscles, a fair outside, increasing weight, florid faces, then a touch of disease and quick death.

"It was as if the system had been kept fair outside, while within, it was eaten to a shell, and at the first touch there was utter collapse; every fiber was poisoned and weak. Beer-drinking is very deceptive, at first; it is thoroughly destructive, at last."

Some companies will not insure the lives of liquor-sellers, because they know that they are so often liquor-drinkers.

HEREDITY.

You have learned enough about your body by this time, to understand that when people are sick, it is generally their own fault; either they have not been taught how to care for their bodies, or they are heedless in spite of their knowledge.

But sometimes, one is sick or suffers very much, because of wrong things that his parents or grand-parents did. Does this seem strange? Some one has told you, perhaps, that you have your father's hair and eyes, but that your mouth and chin are like your mother's.

You have heard of children who were

quick-tempered, or generous like their parents. Not only property, but faces and character are inherited. Our lives are very closely linked with those of our "blood relations," and evil tendencies, as well as good impulses, descend from them to us.

Over in the poor-house, is a man who does not know so much as most children four years old. He can not learn to read or write; he is an idiot. And this is because he is the child of drinking parents whose poisoned life-blood tainted his own.

Many men and women are insane, because they inherit disordered bodies and minds, caused by the drinking habits of their parents; and the descendants of "moderate drinkers" suffer in this way, as well as those of the drunkard.*

* One of the most serious objections to the use of alcoholic liquors in any quantity, is the taste it creates, the habit it establishes—a taste and habit often transmitted from parents to their children—and the very great danger, by continuance in the indulgence, of its resulting in gross, degrading, habitual drunkenness.

Even if a moderate indulgence had no other evil effect, this danger is so great, and the influence of the example on others is so bad, as to cause every wise and good man, woman, or child, to avoid it altogether.

Everybody knows it does incalculable harm, and if it does no

"Probably no one ever suffered from all the diseases produced by alcohol, but all habitual drinkers sooner or later experience one or more of them."* And their children are likely to inherit a stronger appetite for narcotics and a weaker will with which to control it.

Tobacco and opium produce similar results. This is called the law of heredity† (hē rěd'ī tȳ). It is one of God's laws, and, like

positive good, there is the best possible reason for "total abstinence."—*Dr. A. B. Palmer.*

* Prof. H. Newell Martin, of Johns Hopkins University.

† "Three-fourths of the idiots born are the children of intemperate parents."—*Dr. Howe.*

"Where drinking has been strong in both parents, I think it a physical certainty that it will be traced in the children."—*Dr. Anstie.*

"One more example which has come under my own professional observation, may be useful. A gentleman of position, sixty-four years of age, is an hereditary drunkard. So violent is he that his wife and family had to leave him.

"One of his sisters has lost her mind through drinking. When drunk, she has frequently tried to commit suicide by jumping from a window, and by drowning. Her insanity has so suicidal a tendency that she can not be left for a moment alone. She will do any thing for drink—will beg, borrow, or steal, pawn everything she can lay her hands on, and even essay robbery with violence in the hope of obtaining money to gratify her morbid craving for alcohol.

"Another sister is also an habitual drunkard, who gets into fits of ungovernable fury when in drink, and is dangerous both to herself and to others.

"The fatal legacy in this case was from both parents. The father shot himself when insane from the use of alcohol, and the mother was a drunkard. The grandfather was also a confirmed inebriate."—*Norman Kerr, M.D.* (See also Appendix, note ▀.)

just earthly laws, helps right living and punishes those who disobey it.

The English-speaking races have descended from men who were hard drinkers. Our ancestors, the old Northmen, were famous for their wild feasts, at which they drank immense quantities of mead—a fermented liquor made from honey and milk. In the early days of the English nation, wine and ale were every-where used.

In the early part of this century, cider and rum were generally used by the farmers of our country as well as by other people; and no wedding, funeral, or public gathering of any sort, was without its free liquor.

The ignorance at that time in regard to the origin, nature, and consequences of alcohol, is shown by the fact that the first temperance pledges signed in this country, prohibited the use of liquor “save at weddings and funerals,” and the taking of “alcoholic drinks, excepting wine, beer, and cider”.

The hardy out-door life which was led by so many of our forefathers, prevented them

from feeling the full effects of their poisonous beverages.

The English and Americans of to-day are descended from these drinking ancestors, and inherit from them a craving for alcohol, and are safe from the poison only when they let it entirely alone.

The taking of a single glass of liquor, the eating of brandy sauce or wine jelly, may rouse this inherited desire, though its possessor may not have discovered that the taint is in his blood; the appetite, becoming uncontrollable, may bring its owner to a drunkard's grave.

QUESTIONS.

1. Does alcohol give strength for work? Illustrate.
2. Give Sir Wm. Fairbairn's statements in regard to the use of alcohol and tobacco by the men in his workshops.
3. Why have those who never drink liquor a prospect of living longer than those who do?
4. Name good preventives of such diseases as cholera and yellow fever.
5. What do the records kept by life insurance companies prove in regard to total abstinence?
6. What class of men will insurance companies not insure?
7. If we are sick, whose fault is it usually?
8. By the faults of what other persons may our illness sometimes be caused?

9. What physical traits are often inherited?—what mental traits?
10. How do the habits of drinking men and women affect their descendants?
11. What is this law called?
12. From whom do English-speaking people inherit the taste for alcohol?
13. How were liquors used in America, a few years ago?
14. Why did not our forefathers feel the full effect of the liquor they drank?
15. Is it safe to take “the first glass”?—why?

CHAPTER XV.

NERVE-ACTION.

STRUCTURE OF NERVES.

Each nerve appears to be a bundle of small fibers; when viewed under a strong microscope, the separate fibers are seen to be really very small tubes.

These nerve-tubes do not branch off from larger nerves as the smaller arteries branch from the larger, but lie side by side, bound together by delicate membranes.

Each tiny nerve-tube is distinct from the others as it passes into the brain. Were it otherwise, we should often be confused and often in danger.

If the nerve-tubes from your first finger were to unite with those from your thumb, so as to make one large tube, you could not tell, unless you used your eyes, whether you pricked your finger or your thumb.

If the nerve-tubes from the feet united

to make one large tube, you could not know by feeling, alone, which foot was cold, cut, or bruised. But when a fly lights on your hand, you do know perfectly well that he is not on your face; the nerves carry word of his presence to the part of the brain which has to do with your hand.

KINDS OF NERVES.

In studying the heart, you learned that two sets of nerves were necessary to its proper "beating." So the lungs, brain, and other organs, are kept at work by certain nerves and held from overaction by other nerves which serve as "brakes."

By other sets of these signal lines, we know about the world around us. We can not hear with our eyes, nor smell with our ears; for the nerves of sight are affected by light only, those of hearing by sound only.

By the nerves of smell, we perceive different odors; by those of taste, we enjoy food and drink, and dislike some medicines and various disagreeable things; while by those of touch, we are told about the various

objects with which we come in contact—as, for example, whether they are hard or soft, rough or smooth.

In the cutis, too, lie the ends of those fibers, or tubes, by means of which we receive our sensations of pain; and there are other nerves which give us the power of muscular motion.

FIBERS OF FEELING AND OF MOTION.

The two sets of nerve-tubes last mentioned, though they look exactly alike, have two kinds of work to do. However closely they may be bound together, each performs its own task and never interferes with that of its neighbor.

One set—the fibers of feeling—carries messages to the brain from the body; another set—the fibers of motion—brings messages from the brain to the muscles.

It is by this means that the countless motions of the body are performed. The command of the brain is sent along the nerve-line to the muscles, thus giving them the power to move.

HOW THE NERVES WORK.

The nerve-fibers are like those telegraph lines on which messages travel in a single direction only: on one wire, all the telegrams are sent to the central office; while on the other, they are received from the central office.

When the finger touches a hot iron, nerve-ends of the fibers of feeling send the message along up the arm into the spinal cord, and thence to the brain, which feels the pain. At once, the brain sends back over the motion-fibers a message to the muscles in the finger, telling them to remove it from the iron.

All this is done in the twinkling of an eye; and the pain, which seems to be in the finger, is really perceived in the brain; and yet the brain itself may be injured severely without suffering, though it is the seat of all pain.

An iron bar was once driven through the upper part of a man's head and he felt no pain.

INJURIES OF THE NERVES.

The fibers of motion and of feeling look exactly alike, as has been said. The large nerve of the arm or leg is formed of many of these fibers bound together. Near the spinal cord, it is divided; all its motion-fibers come from the front part, all its feeling-fibers from the back part of the cord.

In time of war, soldiers often cut the telegraph lines leading to the enemy's camp; then no message can be given or sent, till the line is repaired.

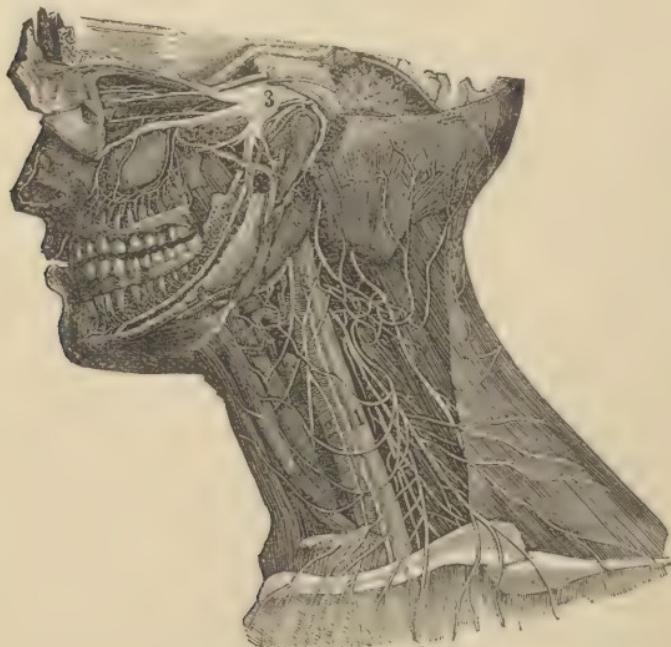
In a similar way, if the back part of the spinal cord, just where the nerve goes off to the right foot, is injured, the sense of feeling in the foot is gone.

You may prick it, or burn it, as much as you please; no pain will be felt, because the nerve fiber which should carry the message of trouble to the brain is injured.

If the front part of the spinal cord is injured at the same place, the order to move the foot may start from the brain; but the muscles do not obey, because they do not re-

ceive it. The message can not get by the broken place on the line. This is how we know there are two sets of fibers connected with the brain-center.

FIG. 28.



Nerves of the face and neck.

Have you ever had your foot soundly "asleep"? You had held it in such a position that the nerves were pressed, and this partly paralyzed them, so that, for a moment, the foot could scarcely move or feel.

If the spinal cord be divided, or seriously diseased or pressed upon, there is no feeling or motion in any part of the body below the point of injury. This is called paralysis (*parăl'y sĭs*), and is quite common.

THE CRANIAL NERVES.

The nerves which start directly from the brain, are called the cranial (*eră'nĭ al*) nerves.

Among these are the nerves of sight, smell, hearing, and taste; those which move the muscles of the face; and those which control digestion, respiration, and the motions of the heart.

From one of these nerves, a number of little branches go to the center of each tooth, and, in case a tooth decays so that either the food or the air can reach them, we suffer severe pain.

Sometimes, the dentist "kills the nerve" by putting against it creosote (*erē'ō sōtĕ*), or some other substance. Then he takes out a piece of the little white thread, and fills the cavity with gold, or some other material, to prevent further decay.

THOUGHT.

But the brain has other important work to do besides merely keeping us alive. It is the organ of the mind. By it, we think and reason: how, we do not know; but God has given us this wonderful instrument, and with it we may do either good or evil.

Every time one does right, it is easier for him to keep on doing right, because he strengthens that part of the brain which is used by the good powers of his mind.

Every time he does wrong, he weakens this part, and strengthens the part used by the powers of his mind for evil—making it much easier to do wrong the next time. Thus we form habits that control us.

In this way, boys and girls who are mean and cruel, whose thoughts are impure and lives untrue, make the men and women who do the mischief and sin of the world; while those whose lives are pure and true, make the men and women who are honored and loved.

One reason why it is almost impossible

for a drunkard to reform, is, because alcohol has deadened that part of the brain which he needs to use in order to master his appetite.

The best quality of brain, as in the case of gifted men and women, seems to suffer the most.

Charles Lamb, a famous English writer, who understood the terrible results of liquor-drinking from his own experience, wrote as follows: "Could the youth, to whom the flavor of his first wine is delicious, look into my desolation, and be made to understand what a dreary thing it is when a man feels himself going down a precipice with open eyes and a passive will—to see his destruction, and to have no power to stop it; and yet to feel it, all the way, emanating from himself; to perceive all goodness emptied out of him, and yet not be able to forget a time when it was otherwise—to bear about the piteous spectacle of self-ruin!"

Little by little, step by step, the drinker is almost sure to lose his power of self-control, until, even through moderate drinking,

"the loss of will unravels the character stitch by stitch."

QUESTIONS.

1. Describe the structure of nerve-fibers.
2. Do the nerve-tubes unite on their way to the brain?—what is the advantage of this?
3. Name the different kinds of nerves.
4. What is the work of the fibers of feeling?—the fibers of motion?
5. Describe the messages sent and received, when the finger touches a hot iron.
6. Where is pain really perceived?
7. What causes your foot to get "asleep"?
8. What is the most important work of the brain?
9. How does one form good habits?—how evil ones?
10. How does the power of habit make it hard for a drunkard to reform?

CHAPTER XVI.

HYGIENE OF THE NERVOUS SYSTEM.

HEALTHY blood is needed in order to have healthy nerves; and proper food, fresh air, and exercise, are necessary to healthy blood.

To keep the mind strong and happy, we must observe the rules of right living, and so protect the brain. When the mind is hard at work, an extra supply of blood is sent to this organ; if it is overworked, too much blood and energy are thus taken from other parts of the body, which then become weak and feeble. Neither brain-work nor muscle-work must be neglected, for both are important.

Rest must also be given to this busy organ, and quiet, dreamless sleep is the best brain-rest. Sleeplessness is often one of the first signs of insanity, that terrible disease in

which the mind loses, more or less, its control over the brain.

Blows on the head are dangerous, and children in their play, as well as older persons, should never give them.

Causes which weaken other parts of the body, weaken the brain as well. Hence, impure air, unwholesome, ill-cooked food, unsuitable clothing, lack of cleanliness—all these tend to injure not only the brain, but the whole nervous system.

The lack of properly prepared food and other unhealthful ways of living, often lead men and women to use alcohol, tobacco, and opium, to deaden their feelings of restless discomfort.

ALCOHOL AND THE NERVOUS SYSTEM.

You have learned how alcohol injures the organs of digestion, so that the food we eat can not make us good blood; and how it unfits the blood for the best use of the body.

About one-fifth of all the blood in the body is in the brain. Through and around

the soft gray matter, in and out among the white fibers, are the tiny blood-vessels.

You know, already, that these enlarge from the drinking of alcohol; the blood then sometimes stagnates, and, at other times, rushes through them too violently. No wonder a headache so often follows the glass of liquor.

Sometimes, an artery bursts, because its walls have been weakened by alcohol so that they can not bear the extra strain; the blood flows out, and death occurs at once. This is called apoplexy (*ăp'ō plĕx ī*), and may result from other causes than the use of alcohol.

But this is not all. The brain asks for good blood, but it gets injured and unhealthful blood. Of course the brain can not be healthy when made of poor material.

A boy can not whittle well with a broken, rusty knife; a musician can not bring sweet music out of a piano whose strings are not in tune; and the mind can not do good thinking, if it has to work through an unhealthy brain.

A large share of the water in the body is

contained in the brain and the nerves, and alcohol unites with this water, taking it away from the parts where it is needed. More alcohol goes to the brain of the drinking man, than to any other organ except the liver; its effect on the nerve-substance is deadening—paralyzing—as you have learned.

The drinking man may not feel pain from his inflamed stomach, partly because it has but few nerves of feeling, and partly because these are out of order and fail to carry messages correctly. Supposing the alcohol has been a good friend, he satisfies the craving it has caused, by another dose.

Perhaps he takes it under the name of “Bitters,” or “Patent Medicine,” ignorant of the fact that most of these are only extracts of herbs mixed with alcohol, and that the harm done by the alcohol more than balances the good gained from the herbs.

When the brain is partly paralyzed by this narcotic, the man does not know what he is doing—his power of thought is deranged, and that of correct thought is gone—he is “crazy with liquor.” He believes himself

stronger in body and mind; he sometimes talks faster, but thinks less wisely.*

"The word of a drunkard, especially with regard to his drinking habits, can not be trusted. An old, but true, proverb says: 'A drunkard is a liar.' His love of truth seems entirely destroyed. And 'the tendency to

* "Among the immediate effects of a few doses of alcohol, are drunkenness, and, in rarer cases, crazy drunkenness and alcoholic convulsions or fits.

" Still further use of the poison, brings on delirium tremens (*dē lir' i üm trē' mēns*), and various maladies of the stomach, liver, kidneys, lungs, and other organs of the body; insanity, and another disease of the nervous system, called dipsomania (*dip so mā' ni a*); the latter is an intense craving for alcoholic or other narcotic substances.

" This uncontrollable desire for liquor does not appear in those who have never used alcoholic drinks; but sometimes, the first indulgence awakens the desire. With others, only a longer use will produce it.

" Most persons, in their earlier indulgence, think themselves capable of controlling their habits, and indulge without apprehension of danger.

" Even when that danger is apparent to others, it may not be to them, until the desire and the habit are too strong, the will too weak, or the indifference to consequences too great for any effectual effort to change this course.

" The longer the indulgence, the stronger the habit, the feebler the resistance, and the greater the indifference—until the victim is swallowed up in his self-invited destruction.

" From this view of the facts, it becomes too obvious to need repeating, that the remedy for drunkenness as a vice, and ineptiety as a disease, is abstinence from alcoholic drinks.

" It would be an insult to the intelligence of the reader to say that the remedy for drunkenness is the use of wine or beer, of which alcohol is the essential and active ingredient."—*Dr. Palmer.*

untruthfulness often descends to his children.' "—*Dr. B. W. Richardson.*

Many railroad companies will not employ drinking men as engineers, since they can not trust them to run their engines safely. Many battles have been lost, because the generals in command were so intoxicated that they could not properly order their troops.

If more liquor is taken, the paralyzed nerves can not control the muscles, the man staggers, his hands tremble, and are beyond his proper control. The brain is still more affected, and the drunken talk and actions show too plainly that alcohol has conquered all the better part of the man.

It is fully proved that a large number of crimes for which men are sent to prisons or jails, are committed when they are in this condition.

A noted murderer confessed that never, but once, did he feel any remorse. Then he was about to kill a babe, and the little creature looked up into his face and smiled.

"But," said he, "I drank a large glass of brandy, and then I didn't care."

The poison deadened his nerves and brain, the better part of his mind—his conscience—was thus put to sleep, and the evil of his nature controlled him. Many a man spends the most of his life behind prison bars, for crimes that he would have shrunk from with horror, had he not been drunk when he committed them.

The drinking of a very little alcohol is enough to deaden, to some extent, the noblest powers of a man's mind, and to make him careless about the results of his actions. But anger, cruelty, fierceness—the baser tendencies, in which he is like savages and wild beasts, are not overcome until he is "dead drunk."

Then all signs of life are gone, save breathing and the motions of his heart. Probably the brain of a man who has once been "dead drunk," can never be so strong and perfect as it otherwise would have been.

ALCOHOL AND SLEEP.

The exact cause of sleep is unknown; but we do know that in healthful sleep, the heart

beats more slowly than when one is awake; the breathing is less rapid; and less blood is coursing through the brain.

Alcohol interferes with all this, and the sleep caused by its use is not healthful brain-rest, but a heavy stupor from which the drinker wakens tired and often suffering.

A narcotic has no power to cure fatigue—it can only deaden the nerves for a while, and thus prevent one while under its influence from knowing that he is weary.

ALCOHOL AND THE MIND.

No man can explain the connection between body and soul, the brain and the mind. We simply know that a sound mind goes with a sound body, a healthy mind with a healthy brain. Alcohol never helps a healthy body.*

The craving for itself which the poison sets up in the system, tends to the destruction of health, character, friends, happiness,

* "Indirectly, alcoholism favors the production of nearly all diseases, by lessening the power of resisting their causes; and it contributes to their fatality, by impairing the ability to tolerate or overcome them."—*Prof. Austin Flint.*

usefulness, mind, and life. The only safe course is never to drink alcohol in any form; or, if the habit is formed, to break it off, at once and forever. The sudden ceasing to drink is not a danger, but the wise way of recovering lost health. Men in state-prisons are not made sick by having their supply of liquor taken entirely away.

TOBACCO AND THE NERVOUS SYSTEM.

Dizziness and partial paralysis are common results of the use of tobacco, especially by the young. The deadening of the nerves explains the "quieting" power of cigars.

When the first effect of the tobacco has passed away, the abused nerves are very likely to tell the user of their discomfort, by leading him to be irritable and unhappy.

What would you think of a young man who, if his father gave him \$1,000 to start him in business, should at once burn up \$500, and then begin work with the rest?

Just so foolish is the boy who destroys the God-given powers of his mind and body, by the use of tobacco. He is cheating him-

self, throwing away a large part of the energy and strength which he needs for the work of life.*

It is even worse than this; for often one of the first effects of tobacco and alcohol is to make one ungentlemanly and forgetful of the rights and feelings of others.

Tobacco-users often smoke in the faces of other people, without once thinking of the impoliteness of such an act, or that the odor of the tobacco may make others very sick; the smoker "does not think" or does not care—he is enjoying "a good smoke."

These are not gentlemanly acts, but they are the very habits to which the use of tobacco often tends.

In many cases, tobacco acts as the usher at the door of the saloon, because the dryness of the mouth which it produces, makes the user thirsty. But it is not a natural

* Young men who use tobacco, say: "It does not hurt me." Does not hurt you! Wait and see. In years to come, when you ought to be in your prime, you will, probably be a poor, nervous, irritable, nerve-dried creature. Your hands will tremble, your head will ache, your sleep will be fitful and disturbed, and your stomach out of order.

Sins against the laws of health, not punished at one end of life, are sure to be at the other.—(Adapted from J. R. Black.)

thirst,—it can not be satisfied by water; for tobacco so affects the nerves, as often to make one crave another narcotic.

Those in charge of inebriate asylums say that nearly all their patients have been users of tobacco as well as of alcohol.

A boy who uses tobacco, must not only pay out much money, but must give up a large share of his health and manhood, in return for its use.

In Germany, children under sixteen are forbidden to use it; the same is true of the pupils of the public schools in France; and of the students in the United States Naval Academy at Annapolis, and in the Military School at West Point.

Those who run races or engage in rowing matches, are denied alcohol and tobacco while in "training." Each man would be glad to have his opponent drink a single glass of liquor just before the contest, so as to weaken him and make his nerves unsteady.

"In a word, alcohol [and, we may add, tobacco] disappoints and betrays all except those who seek sloth and death for body

and mind. It is pre-eminently a destroyer in every department of life."—*Axel Gustafson.*

OPIUM AND THE NERVOUS SYSTEM.

The opium-eater looks old while yet young. It is harder to break off from the use of this drug, than from that of alcohol or tobacco.

In sickness, it often relieves pain temporarily; but when long continued, and always if taken in health, it paralyzes the nerves and throws the telegraph lines of the body out of order, so that no correct message can be given or received, and deranges, often beyond repair, the whole system.

It is a true narcotic. If a certain amount quiets the brain to-day, more must be taken next week to produce the same effect. The opium-user is so enslaved by the poison, that he will lie, or steal, or commit even worse crimes, to obtain the fatal drug.

The eyes of the opium-user become heavy, dull, and listless, his motions are slow and languid. Sometimes persons, who are addicted to the use of this drug, fall asleep even while talking; and they are sure to be

very fretful and nervous, if deprived of their usual portion. But its evil effects are not so apparent as are those of alcohol, hence it is even more dangerous.

CHLORAL AND THE NERVOUS SYSTEM.

Chloral is also used to quiet the brain and induce sleep. It, too, must often be increased in dose. Its continued use greatly injures the health, and there is constant danger of taking a fatal overdose.

QUESTIONS.

1. What are necessary to the making of healthy nerves?
2. How does muscle-work help brain-work?
3. Why is sleep needed?
4. How do unhealthful ways of living lead to the use of narcotics?
5. Where are the blood-vessels in the brain?
6. How does the drinking of alcoholic liquors affect them?
7. What is apoplexy?
8. How is the water, contained in the brain and nerves, affected by alcohol?
9. Why does the drinking man feel no pain from his inflamed stomach?
10. What is the danger in using "Bitters" and "Patent Medicines"?
11. Explain the term, "crazy with liquor."
12. Why does a drunken man stagger?
13. What powers of the mind are first deadened by alcohol?—what powers are the last to yield?
14. What are the characteristics of healthful sleep?

15. Do narcotics "cure" pain and fatigue?
16. Explain the "quieting" power of cigars.
17. How does tobacco affect the courtesy of the user?
18. How does its use often lead to the use of alcohol?
19. State the laws of different countries in regard to the use of tobacco.
20. Describe the effects of opium on its user.

CHAPTER XVII.

SPECIAL SENSES.

TASTE.

THE ORGAN OF TASTE.

THIE tongue helps in the acts of chewing, swallowing, and speaking, but it is the special organ of taste.

The nerves of taste are mainly in the papillæ of the tongue; as they are covered by a thin skin—the mucous membrane—food must be dissolved so as to pass through this skin before it can be really tasted.

If one eats rapidly, he not only injures his stomach, but loses much of the flavor of the food. When the tongue is coated, as in a fever, the sense of taste is impaired or, sometimes, lost.

The nerves of the front part of the tongue taste sweet and sour things; those of the back part, salt and bitter things. The former

are connected with those of the face, so, when you eat something sour, your face is likely to "pucker up." The latter are connected

FIG. 29.



The tongue, showing the three kinds of papillæ—the conical (D), the whip-like (K. I), the entrenched (H, L); E, F, G, nerves; C, glottis.

with the nerves of the stomach, hence bitter tastes often make us "sick at the stomach."

SMELL.

THE ORGAN OF SMELL.

The nose is the organ of smell. It is composed of bone and gristle. It is connected with the back part of the mouth, and is lined, like the throat, with the mucous membrane. It is divided into two parts called nostrils.

The nerves of smell enter the nostrils through small openings in the bone at the back of the nose.

The sense of smell helps us to decide what things to eat. If, for instance, the nose were on one side of the mouth, we should not be so likely, as we are now, to smell food before eating it, and should be in much more danger of eating things unfit for food.

When we must swallow something that is not pleasant to the taste, like some kinds of medicine, it is well to shut the eyes and hold the nose; it will not be so disagreeable, if we use the sense of taste alone.

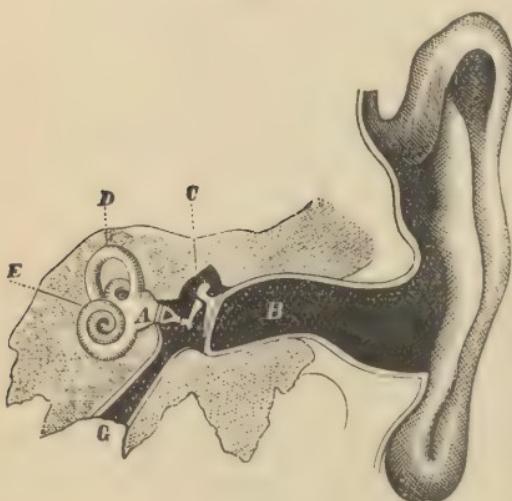
Impure air often warns us of its presence through our sense of smell.

HEARING.

THE ORGAN OF HEARING.

The ear is one of the most difficult parts in the whole body to study or understand. It is divided into the outer, middle, and inner ear.

FIG. 30.

*The ear.*

When we speak of the ears, we usually mean the curiously shaped pieces of gristle on the sides of the head. Their principal use seems to be to help catch the sound.

The opening which passes from these into the head

is called the auditory (*əd'**ɪtɔr̥y*) canal. This extends to the middle ear, or the "drum" of the ear, as it is sometimes called. The "head" of the "drum" is a delicate membrane which is stretched tightly across the inner end of the auditory canal.

Both the middle and the inner ear (which

lies deeper in the head) are in the solid bone of the skull, and are thus carefully protected from injury.

A tube leads from the middle ear to the throat. Perhaps you have noticed that old people who are a little deaf, open their mouths when they want to hear distinctly. This is to let the sound pass in through this tube, as well as through the auditory canal.

Very small bones, strangely curved tubes, a little water, and millions of tiny nerves of hearing, are found in the middle and in the inner ear.

CARE OF THE EARS.

Very cold water should not be used in the ears, nor should a draught of cold air be allowed to enter them.

No hard substance, like a pin, should be pushed into the canal; for it might break the "head of the drum," and when this happens, the sense of hearing is injured.

If there is too much ear-wax, it will often fall out of itself, in fine scales. It may, however, accumulate and require to be carefully

removed. A “box on the ear” should never be given; there is great danger of its making one deaf. Pulling the ears is a cruel and injurious practice.

TOBACCO AND HEARING.

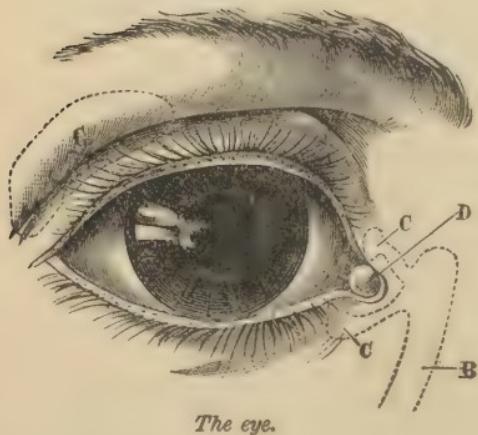
Ringing sounds in the ears and partial deafness sometimes result from the use of tobacco.

SIGHT.

THE ORGAN OF SIGHT.

The eyes are placed in deep, bony sockets in the head, and are protected by the brows and lids.

FIG. 31.



The eyebrows are projections of skin covered with short, stiff hairs; the eyelids are two flaps, or curtains, of somewhat gristly skin.

They have oil and sweat-glands like the rest

of the skin, and a row of hairs grows from each edge. These hairs, or eyelashes, help to keep dust out of the eye.

The tears come from a gland that lies above the eye, and just within the outer edge of its roof. Every time you wink, some of this moisture is washed over the eyeball, clearing it of dust. The overflow passes by a small tube, into the nose.

Grief, or even great joy, makes the tears flow so freely that they run down over the cheeks. The eyeball, by means of nerves and muscles, can move inward, outward, upward, and downward.

The "white of the eye" is a hard coat which protects the parts beneath. The colored circle—that which makes us call the eyes black, or blue, or brown—is the iris (*ī'ris*). It is like a circular curtain with a hole in the center called the pupil.

When the light is too bright, the pupil contracts; when too dim, it enlarges. This is done by muscular fibers that run round the hole somewhat like the string in a hat-lining; they contract and so draw the sides

of the pupil together, or stretch and make it larger.

A cat's eyes can do this better and more quickly than ours. They need to be able to see their prey in the dark, and so can open their pupils very wide.

Back of the iris are various fluids and parts, all of which help us to see. The fine nerves of sight form a delicate expansion or coat, which is the inner lining of the eye.

CARE OF THE EYES.

Looking at a bright light or directly at the sun, dazzles the eyes and may greatly injure them. Weakness of vision and sometimes blindness result from allowing sunlight or an artificial light, to shine directly into an infant's eyes.

Squinting or rolling the eyes, even "for fun," is a dangerous practice, because it strains the muscles which should hold the eyeball in place.

School seats ought not to face the windows, and one should never read or write with strong sunlight falling on book or

paper. Reading in the twilight, or on the cars when in motion, strains the eyes.

In reading in the evening, be sure you do not face the artificial light; let the lamp be shaded and the light fall from behind; for writing, the lamp should be behind, and at the left, so that the shadow of the hand will not be in the way of the pen.

A lighted lamp, standing on a white or red cloth, and facing a person, as at the tea table, is very trying to the eyes; the cloth should be of a neutral tint, drab or brown, and the light so placed as to be above the level of the eyes.

Sleeping-rooms should be partly darkened, so that on waking in the morning, the eyes may not be required to meet suddenly a bright light.

Cinders may be removed from the eye, by a little loop of fine thread or hair.

TOBACCO AND SIGHT.

Imperfect sight, and specks of light dancing before the eyes, sometimes result from the use of tobacco.

A certain kind of blindness is caused by this drug, and is cured by stopping its use.

QUESTIONS.

1. Where are the nerves of taste?
2. Which of them are connected with the nerves of the stomach?—with those of the face?
3. Describe the nose.
4. How does it act as a sentinel?
5. Describe the ear.
6. What care should be taken of the ears?
7. How does tobacco affect the sense of hearing?
8. How is the eye protected?—how kept free from dust?
9. How is the eyeball moved?
10. Describe the eye.
11. Why can a cat see better in the dark than we can?
12. How are the eyes often injured?
13. How should a light be placed for reading or writing?
14. How does tobacco affect the sense of sight?

A P P E N D I X.

WHAT is "temperance physiology"? What must be taught—what must not be taught—in connection with the effects of alcoholic drinks and other narcotics on the human system?

1. Regulation or extermination of the liquor-traffic, low license or high license, moral or legal measures, temperance as a political issue—questions like these have no place in the physiology classes. Teachers may and should have, as citizens of the republic, their individual opinions on these points, but the physiology class is not the place for expressing such opinions.

2. Tirades against liquor-selling, and personalities, are out of place in class work. The teacher needs to be on the watch lest some child refer to Mr. A., the drinking father of a pupil, or to Mrs. B., whose habit of opium-using is well known in the community. These illustrations may, indeed, come to the mind of every child, but bid the lips be closed that would thoughtlessly wound another by their mention.

3. The medical use of alcohol is a point still widely in dispute, but one that does not belong in a common school text-book. It is quite within the

province of hygiene, however, to teach efficient substitutes for alcoholics as simple home remedies.

4. The proven facts of science are amply sufficient for the purpose sought, without resorting to doubtful experiments, or overstatements.

5. Insanity, idiocy, and criminality, as connected with the use of narcotics, must not be overlooked; let these dangers, both direct and indirect—through the law of heredity—be made evident to the pupils.

CHAPTER I.—Food.

It will add to the interest, if the children are encouraged to make a “food-collection” in illustration of the text. Use small, neatly-labeled vials or boxes, to hold salt, the various grains, arrow-root, sago, corn-starch, sugar, terra alba, glucose, pepper, tea, coffee, cocoa etc.

CHAPTER II.—Alcohol.

“I know there’s no alcohol in my currant wine,” says the thrifty housewife, “for I made it myself, and I didn’t put in a drop.”

“Cider’s nothing but apple-juice,” cries the old farmer.

The true origin of alcohol should be made so clear to the mind of the pupils that they will not be led astray by these fallacies. Be sure that they understand that alcohol is not (save as an after-act) “put into” fermented fruit-juices, but that it comes there of itself, under the right conditions.

The use of alcohol for burning, and its affinity for water, are easily illustrated.

CHAPTER III.—Fermentation.

EXPERIMENT 1.—Add molasses to water in a bottle till it is of a deep brown color, then add a teaspoonful of yeast; allow it to stand in a warm place for a day or two. Then note that the mixture has the odor of alcohol; later, a sour, acid odor. The little yeast-plant has changed the sugar of the molasses to alcohol, and later, the alcohol has changed to an acid.

EXPERIMENT 2.—Allow apple-juice to stand exposed to warm air for a few days. The liquid acquires the odor of alcohol, and later, that of vinegar. Ferments from the air have changed the sugar of the apple-juice to alcohol. By exposure to the air, the alcohol has changed to vinegar.—*Adapted from Arthur C. Boyden, A.M.*

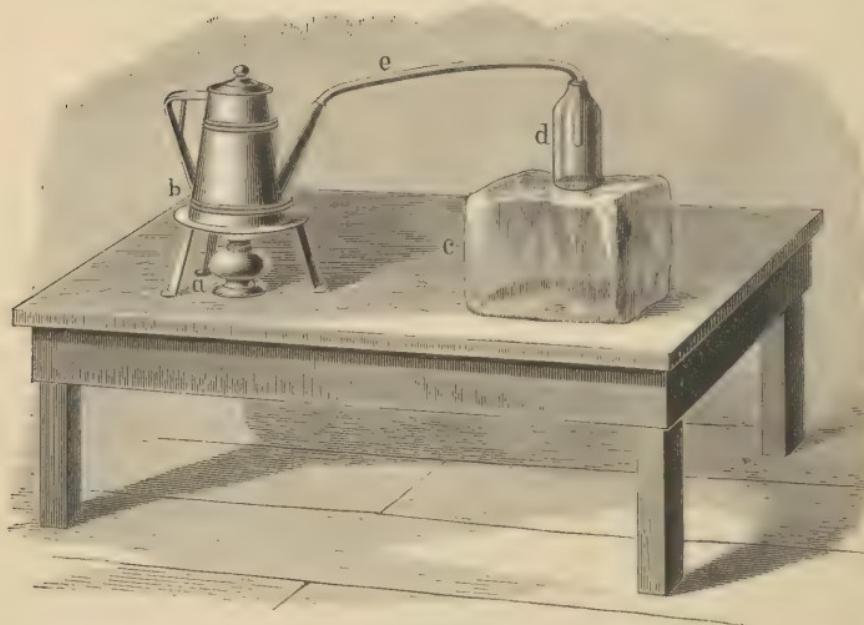
CHAPTER IV.—Distillation.

The same truth—the presence of alcohol in even the milder liquors—may be shown by the process of distillation. The experiment is easily made.

Put some hard cider into a teapot (*b*), and fasten a piece of rubber tubing (*e*) about two feet long to the spout.

Let the other end of the tubing reach into a bottle (*d*) standing in a pail of cold water or on a block of ice (*c*).

FIG. 32.

*Distillation.*

Heat the cider by means of the lamp (a), being careful not to make it hot enough for the water in the cider to boil. The vapor will turn to a liquid in the cool tube, and drip from the end into the bottle. Test it with a lighted match.

If the cider is not very strong, you may have to re-distill it before you find the alcohol is pure enough to burn.

It is mainly alcohol which has been separated—distilled—from the fermented mixture. What remains in the kettle is principally water. The alcohol is unchanged in its nature, but is stronger, because not so much diluted with water.

The alcohol usually sold is distilled from fermented molasses; but it can be made from any fermented liquor. It is so greedy for water that entirely pure alcohol can be produced only by distilling it with some substance such as lime, that is still more eager for water, and will take it from the alcohol.

CHAPTER V.—Tobacco.

The following testimony from the Principal of the Iowa State Normal School is a danger-signal that teachers will do well to heed:

“After making a study of several hundred boys, running through a period of ten years, I give only observed facts, and neither assume the conditions nor jump at fore-ordained conclusions.

“1. Boys that begin the habit at an early age are stunted physically, and never arrive at normal bodily development.

“2. Accompanied with the use of the narcotic were certain disordered physical functions, such as indigestion, impaired taste, defective eye-sight, dull hearing, nervous affections, and diseases of the heart. I have not found a single case of early addicting to the habit of tobacco-using that did not suffer with one or more of these direful abnormal conditions.

“3. Tobacco used in any form, destroyed the ability to apply one's self to study, and prevented his comprehending or remembering his lessons. The mental faculties of a boy under the influence of the narcotic seem to be in a stupor, and since depraved

nerve power stultifies and weakens the will power, there is but little use for the teacher to seek to arouse the dormant, paralyzed energies, or to interest and foster the fagged desire. I have not met a pupil that is addicted to the habit who will go through a single day's work and have good lessons. I have never had one whose scholarship record was good, and in almost every case the deportment was below the average standard. At the regular examinations for promotion, nearly every one of the tobacco-using pupils fail in doing the most reasonable test work, even if this is not the first time the work has been passed over in class. I have had numbers of cases in which they have remained in the same grade for four successive years, and then they were not ready to be advanced into the next higher class.

"But the moral results are also as serious. Pupils under the influence of the weed are constant subjects of discipline, are not truthful, practice deception, and can not be depended upon. A change in character in a formerly good boy is a very strong indication that some habit is getting hold upon him whose tyranny must be broken before he will again be clothed in his right mind. The worst characteristic of the habit is a loss of personal self-respect, and of personal regard for the customs and wishes of ladies and gentlemen, especially when among strangers.

"If these observations mean any thing, they declare that something ought to be done to save child-life from the pitfalls that commercial interests are digging, and that greed is encouraging; that

more should be done than to instruct by oral or text lessons in schools; that teachers, parents, and philanthropists are not yet sufficiently aroused regarding the magnitude of the evil of tobacco-using by children; that in the crusade against alcohol we should recognize that other evils, though more quietly, are just as surely sapping the strength and destroying the vigor of the youth of this generation."—*H. H. Seerley.*

CHAPTER VI.—The Nervous System.

STIMULANTS.

Because it is difficult to define clearly and exactly such terms as food, poison, stimulant, etc., there has been much dispute as to whether or not alcohol should be called a stimulant. Careful examination and balancing of the statements of medical authorities have resulted in the conclusions given in the text. The point is an important one, because many persons cling to the use of liquor for—as they say—its "stimulating," "tonic" properties.

The following quotations are in proof and explanation of the position taken. *Note carefully* that the paralyzing effects of small doses, or the first effects—whatever be the amount taken—are on the *inhibitory nerves*—those which control the action of the internal organs, as the heart. Later, the staggering gait and trembling hands, show the partial paralysis of the nerves of motion, and, in complete intoxication, the nerves of feeling are also deadened.

"I will define *stimulant* to mean such food, medicine, or exercise as would in itself be energizing. Narcotics, on the contrary, are poisons of a paralyzing nature, and may be divided into two classes: *plain narcotics*, or those whose paralyzing effect is patent, and *pseudo-stimulants*, or those narcotics whose numbing effects assume the guise of temporary stimulation, inasmuch as their action is expended primarily upon the inhibitory centers. Most of these narcotics are, in small doses, pseudo-stimulants, and in large doses plain narcotics. Alcohol is pre-eminently of this double character; a pseudo-stimulant when taken in small doses, and a plain narcotic when heavily imbibed.

"With the small—the pseudo-stimulant—dose of alcohol, there is temporarily all the appearance of heightened activity, but the life-forces expend themselves to no purpose—or to a purpose which should not have existed, the necessity to dispose of the intruder. The paralyzing effect of alcohol on the nerves may be compared to the effect produced on the machinery of a clock, by a gradual reduction of the weight of its pendulum; the machinery runs faster and faster, but this activity is valueless—the real principle, the time-keeping faculty, is paralyzed.

"Thus the animated appearance, the throbbing of the arteries, the peculiar sparkle in the eye, the flush of the face, and the activity manifested by the drinker, are signs of danger. The extra activity is caused by the systematic effort to avert harm, and originates in the incipient paralysis of the nerves

caused by alcohol. In the case of death by freezing, when the cold has paralyzed the nerves of sensation, happy visions of shelter and warmth lull the sufferer into the fatal sleep. A like incipient paralysis of the nerves furnishes the pleasing sensations resulting from the use of alcohol.”—“*The Foundation of Death*,” by Axel Gustafson.

“Alcohol is never a stimulant at all when we come to examine it. It never acts as any thing but a paralyzer. The so-called stimulating effects of alcohol are really only finer shades of that same narcotic influence which produces general stupefaction and universal paralysis when the agent is given in large doses.”—Dr. James Edmunds, England.

“The flushing of the face (produced by alcohol) is caused by the paralysis of the cervical branch of the sympathetic. There is no stimulation. There is nothing but paralytic disorder from the moment narcosis begins.”—Prof. John Fiske, Cambridge, Mass.

From careful experiments in which the quantity of liquors used was “two drachms of alcohol,” representing “not quite half a glassful of port or sherry; a small wine-glassful of claret or champagne; and not quite a quarter of a pint of ale,”—quantities so small as usually to be considered harmless,—Dr. Ridge makes the following conclusions:

“The fact is established that, from the moment when sufficient alcohol has been taken to affect the nervous system at all, to the total extinction of nervous energy by a fatal quantity, there is *progressive paralysis* of every form of nerve function, capable of

accurate determination, which has hitherto been experimented on. Alcohol has clearly no right to be called a stimulant. It is a narcotic from first to last, and the symptoms of stimulation are only the result of the peculiar, balanced condition of many functions, between accelerating and checking nerves; the narcotizing of a checking nerve producing for the time being the same visible effect as the stimulation of an accelerating nerve."—*Dr J. J. Ridge, England.*

CHAPTER X.—The Bones.

If possible, obtain the use of a complete skeleton for illustrating this chapter. If the school does not own one, a neighboring physician may, and be willing to lend it, or to permit the class to see it at his office.

When the children have become interested in the mystery of life, have learned something of the wondrous houses in which they live—of the domes protecting their busy brains, through whose windows the soul looks forth—of the skillful combinations of bones and joints—then is the time to show the marvelous frame-work—to show it quietly, and as a matter of course—uncovering but a part at a time, and comparing it with the familiar skeletons of the lower animals.

By all means, secure a skull, if the whole skeleton can not be shown; the other bones can be located readily in the living body, and illustrated by refer-

ence to bones of the lower animals. But the skull, with its crooked "over and over" seams, or fixed joints, its deep eye-sockets, its thin "tear-bones," its cavities for the teeth and holes for the ears—all these are much more clearly understood from the object than from any picture, however accurate.

Perhaps it is needless to add that none of these aids should be used as playthings, nor, on the other hand, should they be held as objects of superstitious fear.

"A sacred burden is this life we bear."

CHAPTER XIV.—Effects of Alcohol in Life.

It is an undisputed fact, that "strong and healthy children can not be born of parents whose constitutions have been worn out with intemperance and disease."

"All the evil resulting from hereditary alcoholism, may be transmitted by parents who have never been noted for their drunkenness. Long-continued habitual indulgence in intoxicating drinks to an extent far short of intoxication, is not only sufficient to originate and hand down a morbid tendency, but is much more likely to do so than even repeated drunken outbreaks with intervals of perfect sobriety between."—*Dr. Norman Kerr, England.*

While learning the facts concerning this law of heredity, the pupil must not be left to think that one thus injured is therefore powerless, or under no obligation to struggle against his evil inheritance.

The conflict is more severe when one suffers for the sins of his parents as well as for his own. But it is, none the less, a duty.

The experience of many men and women, children of drinking parents, proves that it is possible to overcome the hereditary appetite for alcoholics: but, "the first glass," with such persons, is even more dangerous than in other cases. Nor should it be forgotten that hereditary tendencies often leap over one or more steps, the sins of the grandparents affecting their children's children, "unto the third and fourth generation."

INDEX.

A

	PAGE
Abdomen.....	118
Absorptive power of the skin.	141
Absorption of food.....	43
Acetous fermentation.....	29
Air, The.....	86, 90
Albucasis.....	33
Alcohol.....	13
" amount in Liquors.....	26
" a Narcotic	68
" a Poison.....	16
" and Bread.....	25
" and Cold	147
" and Heat.....	151
" and Heredity	157
" and Life Insurance.....	155
" and Sleep	179
" and Water.....	15
" and Work.....	153
" Appetite for.....	70
" Discovery of	33
" Effect upon Blood	104
" " Brain	68, 174
" " Circulation	105
" " Digestion.....	47
" " Heart	106
" " Heat of body	147
" " Kidneys	52
" " Life.....	153, 207
" " Liver.....	51
" " Lungs.....	90
" " Mind.	180
" " Muscles.....	92, 181
" " Nervous System.	174

PAGE

Alcohol, Effect upon Stomach	46
" in Nature	28
" not a Food.....	14
" Origin of	13, 198
" Properties of.....	13
" Uses of.....	13
Alimentary Canal.....	36
Anatomy	120
Ancestors, Our.....	160
Aorta	97
Apoplexy	175
Arteries.....	95
Auricles.....	96
Ayles, Adam.....	149
B	
Bacteria.....	19
Ball-and-socket Joint.....	124
Barley	21
Bathing	140
Beef	127
Beer	21
Bile	51
Bitters	176
Bleeding	103
Blindness	194, 196
Blood, The	93, 97
Bones. The	109, 206
" Broken	113
" Composition of.....	110
" Face	114
" Growth of	111
" Life of	112

PAGE		PAGE	
Bones, Shape of.....	110	Corns.....	122
" Table of.....	119, 120	Cosmetics.....	141
Brakes, The.....	106, 203	Cranial Nerves.....	169
Brain.....	64	Croup.....	85
" Exercise of.....	173	Curvature of the Spine.....	121
Bread.....	25	Cuticle, The.....	136
Breast-bone.....	114	Cutis, The.....	135
Breathing.....	83	Cuts.....	103
" Hygiene of.....	83		
Bronchial Tubes.....	80		
Bronchitis.....	85		
		D	
		Death.....	132
		Delirium Tremens.....	177
		Diaphragm.....	77
		Digestion.....	35
		" Steps of.....	45
		Diphtheria.....	87
		Distillation.....	30, 199
		Drains.....	86, 137
		Drinking-water.....	4, 86
		Drunkards.....	176
		Dyspepsia.....	41
		E	
		Ear, The.....	191
		Eating, Rapid.....	41
		Eggs.....	6
		Elbow, The.....	117
		Epiglottis.....	79
		Esophagus.....	42
		Ether.....	68
		Exercise, Muscular.....	180
		Expansion, Muscular.....	128
		Expiration.....	78
		Eye, The.....	192, 194
		F	
		Fats, The.....	6
		Fermentation.....	18, 199
		" Acetous.....	29
		" Vinous.....	19
		Ferments.....	19
		Fever, Typhoid.....	87

	PAGE		PAGE
Food.....	1, 198	Inspiration.....	78
" Absorption of.....	43	Intestines, The.....	44
" Cooking of.....	10	Iris.....	193
" Definition of.....	1	Iron.....	5
" Digestion of.....	35		
" Heat-making.....	6		
" Kinds of.....	3, 9	Joints.....	124
" Mineral.....	3		
" Need of.....	35	K	
" Sources of.....	1	Kidneys.....	52
" Tissue-making.....	5	Knee-pan.....	117
Foot, The.....	118		
Frost-bite.....	148	L	
Fruit.....	12	Lacteals.....	45
		Larynx	79
G		Lees.....	20
Gall-bladder	51	Life	132
Gastric Juice	43	Life Insurance.....	155
Gin.....	31	Liquors, distilled.....	31
Grains, Alcohol from.....	21	" drugged.....	81
Gristle.....	112	" fermented.....	18, 27, 28
		Limbs, Lower.....	117
H		" Upper.....	116
Hair, The.....	189	Lime.....	5
Hair-dyes.....	141	Liver	50
Hand, The.....	118	Lungs, The.....	80
Head.....	114	" Work of the.....	82
Hearing.....	190		
Heart	96, 102	M	
Heat of Body.....	143	Malt.....	21
" and fermented liquors..	28	Marrow	112
" Sources of.....	144	Mead.....	160
Heredity.....	157	Meals.....	46
Hinge-joints.....	124	Milk.....	9
Hip-bones, The.....	116	Mucous Membrane.....	135
Humerus	119	Mumps, The.....	40
Hygiene.....	120	Muscles, The.....	127
" of the Nervous System....	173	" Hygiene of.....	129
		" Involuntary.....	129
I		" Uses of.....	128
Impure Air.....	86	" Voluntary.....	129
Inorganic Bodies	109	Mummy, The.....	15

N	PAGE	PAGE	
Nails, The.....	139	Positions of the body.....	121
Narcotic Habit.....	75	Pulse.....	101
Narcotics.....	68	Pupil.....	193
Nerve Action.....	166		
" Injuries.....	167		
Nerves, The.....	168, 164	R	
Nerve-fibers.....	165	Radius.....	119
Nerve-tubes.....	163	Respiration.....	77
Nervous Power.....	64	" Diseases of.....	85
Nervous System.....	61, 173	Rest.....	130, 173
" " Parts of.....	63	Ribs, The.....	115
Nicotine.....	55		
Nose, The.....	189		
		S	
		St. Martin, Alexis.....	49
O		Saliva, The.....	40
Esophagus, see Esophagus.		Salivary Glands.....	40
Oil-glands, The.....	138	Salt.....	4
Oils, The.....	6	Scapula.....	116
Opium.....	78, 75	Secretion, Definition of.....	37
" and the Nervous System.	184	Senses, The.....	187
Organs.....	109	Septum.....	96
" of Breathing.....	79	Settlings.....	20
" " Circulation.....	95	Shoes.....	122
" " Digestion.....	36	Shoulder-blades, The.....	116
Organic bodies.....	109	Sight, Sense of.....	192
Oxygen.....	82	Skeleton, The.....	109
		Skin, The.....	135, 141
		Skull, The.....	114
P		Sleep.....	173
Pancreatic Juice.....	44	" by narcotics.....	179
Papillæ.....	136	Smell, Sense of.....	189
Paralysis.....	169	Soothing-syrup.....	74
Patella, The.....	120	Speech, Organs of.....	80
Patent Medicines.....	176	Spinal cord.....	67
Pepsin.....	43	Spinal nerves.....	68
Perspiration, The.....	137	Spine, The.....	114
Phosphorus.....	5	Spores.....	19
Physiology.....	120	Starch.....	6, 7
Pleurisy.....	85	Sternum.....	120
Pneumonia.....	85	Stimulants.....	68, 203
Poison	16	Stomach.....	42
Pores.....	137	Sugar.....	6, 8
		Sunlight.....	142

	PAGE		PAGE
Sunstroke	138	Tongue, The.....	187
Sweat.....	137	Tooth-ache, The.....	39
T		Touch, Sense of.....	186, 164
Taste, Sense of.....	187	Trachea.....	79
Tea.....	10	Training.....	183
Tears, The.....	198	Trunk, The.....	114
Teeth, The.....	37	V	
" Care of the.....	39	Valves of Heart and Veins...	100
Temperature of the Body....	148	Veins.....	95
Tendons.....	127	Ventilation.....	85, 87
Terra alba.....	8	Ventricles.....	96
Thermometer, Use of.....	143	Vertebræ.....	114
Thigh-bones, The.....	117	Vinegar.....	29
Thought	170	Vinous Fermentation.....	19
Tight-lacing.....	84	Vocal Chords.....	80
Tissues, The	109	W	
Tobacco.....	55, 201	Walking.....	121
" and Alcohol.....	182	Waste and Repair.....	35
" and the Heart.....	107	Water.....	4
" Effect on Bones.....	123	" Purity of.....	4
" " Growth.....	123	Windpipe.....	79
" " Hearing.....	192	Wine.....	22, 23
" " Heart	107	Woolen.....	145
" " Mouth.....	57	Wounds.....	103
" " Nervous System.	181	Y	
" " Sight.....	195	Yeast.....	19
" " Stomach.....	58		





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